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Department of the Interior
Bureau of Land Management

PROCEEDINGS OF THE TESHEKPUK LAKE AREA CARIBOU/WATERFOWL IMPACTS ANALYSIS WORKSHOP

MAY 21–22, 1997

FAIRBANKS, ALASKA

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Edited by

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Bureau of Land Management

Northern District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT

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Introduction

Purpose

The Bureau of Land Management held the Teshekpuk Lake Area Impacts Analysis Workshop on May 21 and 22, 1997, to provide BLM with guidance for developing a package of stipulations for an environmental impact statement alternative that would allow oil and gas leasing in the Teshekpuk Lake area (Figure 1). BLM wanted the invited panelists to identify the conditions under which development could be allowed "in a manner which will assure the maximum protection of such surface values to the extent consistent with the [Naval Petroleum Reserves Production Act of 1976]." There were two constraints on discussion at this meeting: the results must allow economically viable oil development, but with protection for caribou and waterfowl.

Scope

- Review options for "reduced-impact oil fields."
- Review existing information pertaining to the response of waterfowl and caribou to oil and gas development.
- Formulate a realistic development alternative that minimizes impacts to waterfowl and caribou.
- Evaluate the likely residual impacts to waterfowl and caribou, under the alternative formulated above.

Format

The workshop had facilitators to help meet the goals in the short time allowed. The panels consisted of agency representatives with knowledge in waterfowl or caribou biology, wildlife interactions with North Slope oil and gas activities, or oil field development. Panel members reviewed relevant studies prior to the workshop. Representatives from the oil and gas industry, as well as invited nonagency biologists, provided background information in an initial information-gathering phase.

The second phase of the workshop was limited to agency personnel, indicated as panelists in the list on page 3. In addition to the invited workshop participants, a letter was sent to various organizations with relevant interests. The letter requested information addressing the questions in Appendix A, or information related to wildlife interactions with North Slope oil developments that would be pertinent to the development of mitigation measures. No responses were received. The draft proceedings of the workshop were distributed to panelists for review. This final edition of the proceedings will be included in BLM's administrative record.

Agenda

May 21:
I. *Overview of Caribou and Waterfowl Use of Teshekpuk Lake Area*
Two brief presentations

II. *Explore Options for Reduced-impact Oil Fields*
Presentation by industry representatives (ARCO), addressing topics such as minimally-staffed oil fields, remote control of production facilities, buried vs. above-ground pipelines, roadless oil fields, minimal air traffic, etc. Discuss advantages and disadvantages of various development options.

III. *Apply the Prudhoe Bay Experience to the Teshekpuk Lake Area*
Waterfowl and caribou panels meet separately. Invited biologists assist in interpreting recent work on disturbance of birds and caribou, and studies emanating from the existing North Slope oil fields. The goal is to define the extent to which studies in the existing oil fields can be used as a model for Teshekpuk Lake.

May 22 (panelists only):
IV. *Formulate Stipulations for Teshekpuk Lake Area*
Waterfowl and caribou panels meet separately. Based on the development options presented

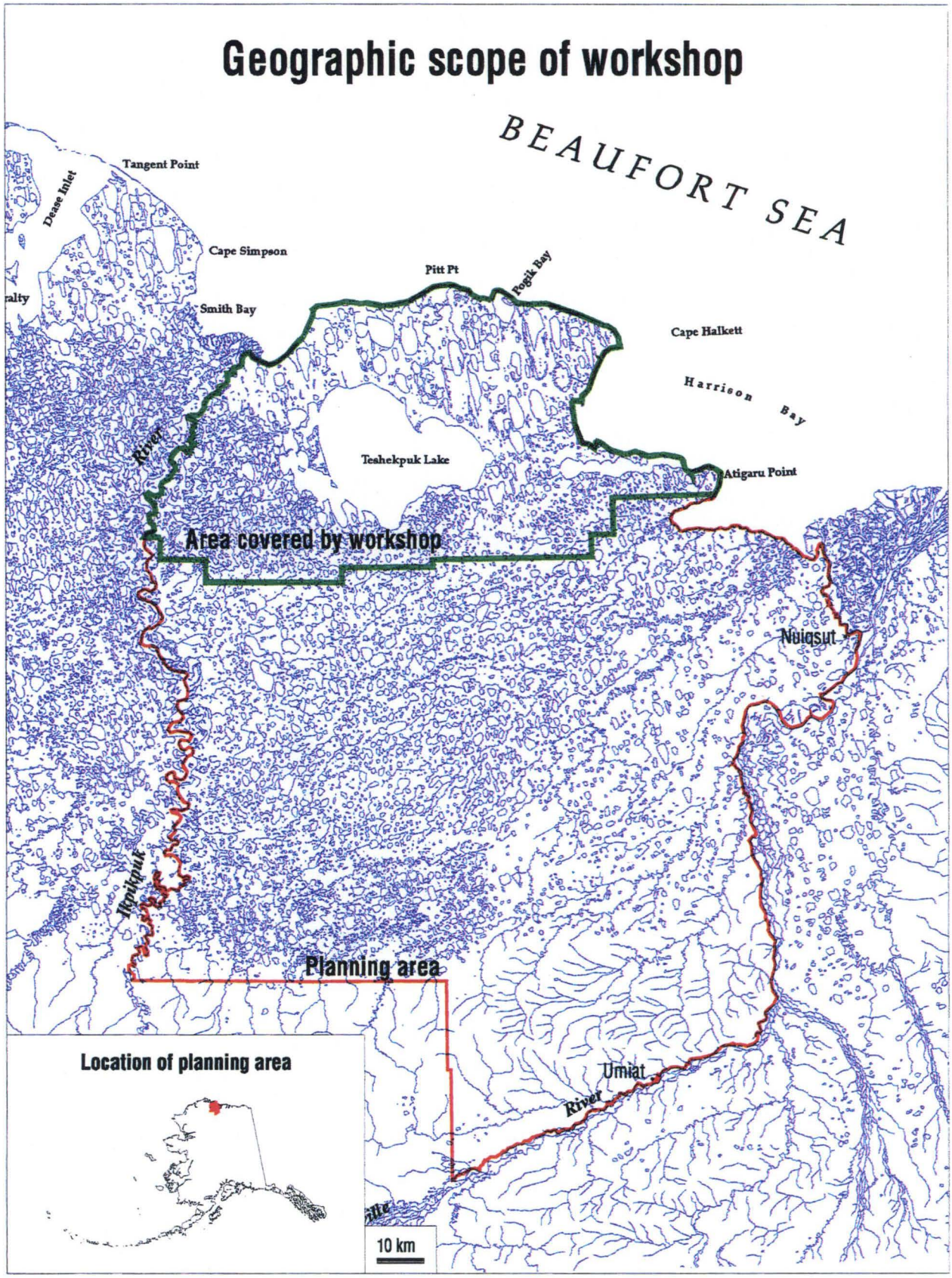

Figure 1. Geographic scope of workshop.

earlier, panelists formulate a set of conditions on oil field construction and operations that would maximize protection of waterfowl and caribou, without precluding oil and gas development.

V. *Synthesis*
Waterfowl and caribou panels meet together to identify conflicts between their respective mitigation plans. Panelists attempt to formulate a unified approach to mitigation for both waterfowl and caribou. Residual impacts and environmental risks of the mitigation plan(s) are assessed.

(Note: The workgroup was not completely successful in accomplishing all of this aggressive agenda during the two days allowed. Follow-up meetings involving a subset of attendees were needed on May 28 and June 2 to flesh out one of the waterfowl stipulations and to merge the two sets of stipulations.)

Attendees

Dave Yokel, BLM (workshop organizer, caribou panelist)
Herb Brownell, BLM (facilitator)
Susan Will, BLM (facilitator)
Ryan Lance, ARCO (invited speaker)
Mike Joyce, ARCO (invited speaker)
Sharon Wilson, BLM (notetaker)
Sue Mitchell, Inkworks (notetaker)
Philip Martin, USFWS (waterfowl panelist)
Joel Hubbard, MMS (waterfowl panelist)
Anne Morkill, BLM (waterfowl panelist)
Tom Rothe, ADF&G (waterfowl panelist)
Geoff Carroll, ADF&G (caribou panelist)
Dick Shideler, ADF&G (caribou panelist)
Brian Lawhead, ABR (invited biologist, caribou)
Brad Griffith, USGS-BRD (caribou panelist)
Alan Brackney, USFWS (waterfowl panelist)
Karen Bollinger, USGS-BRD (speaker, waterfowl)
Gene Terland, BLM (observer)
Jim Ducker, BLM (observer)
Curt Wilson, BLM (observer)
Mike Kunz, BLM (observer)
Johanna Munson, State of AK (observer)
Mark Myers, ADNR (petroleum development specialist, waterfowl panelist)
Joseph Dygas, BLM (petroleum development specialist, caribou panelist)
Jim Craig, MMS (petroleum development specialist, waterfowl panelist)
Dick Roberts, MMS (observer)
Don Hansen, MMS (caribou panelist)
Marie Crosley, ADNR (observer)
Dick Mylius, ADNR (observer)
Pam Rogers, ADNR (observer)
Bill Van Dyke, ADNR (petroleum development specialist, caribou panelist)
Declan Troy, TERA (invited biologist, waterfowl)
Steve Murphy, ABR (invited biologist, waterfowl)
Craig George, NSB (caribou panelist)
Ken Whitten, ADF&G (caribou panelist)
Jack Winters, ADF&G (waterfowl panelist)
Phyllis Casey, MMS (observer)
Frank Wendling, MMS (waterfowl panelist)
Roger Siglin, Northern Alaska Environmental Center (observer)
Robert Suydam, NSB (waterfowl panelist)
Eric Taylor, UAF (invited biologist, waterfowl)

Preliminary Information

Overview of Caribou Use

Ken Whitten of ADFG presented information on caribou in the Teshekpuk Lake and Prudhoe Bay areas. A herd is defined as having a consistent calving area, and the Teshekpuk Lake Herd (TLH) is more consistent than others. When first recognized as a distinct herd, it was estimated at 4,000 to 6,000 animals and was 25,000 at last count. There is a fairly high level of harvest.

As regards potential development in the area, the only herd for which we have data is the Central Arctic Herd (CAH). Its population was similar to the TLH when oil was discovered. It increased rapidly to a peak of 23,000 in 1992, but in contrast to the TLH, it declined to 18,000 by 1995. The first signs of impacts from earliest construction were

that few cows with young calves were spending any time next to roads. The CAH calving grounds, between the Colville and Canning Rivers, are spread out over a greater area than the calving grounds of the TLH.

There are two separate calving concentration areas: one at Kuparuk and Milne Point, and one at Canning River. The road to Milne Point went through the western calving area. Cows avoided the road by one to three miles. As development increased and there were more facilities, there was less use of the area for calving and calving cows moved south and west. Midsummer movements through the area persisted, but caribou have not passed freely. Collared caribou from the western area were in worse physical condition in fall than those from where there was no development. All decline in population has taken place in the portion of the CAH from the developed, western area. In summary, there is no proof of oil field impacts on herd productivity, but there is at least reason for concern. Many of the Prudhoe Bay/Kuparuk developments were designed 15-25 years ago; future development may not be the same. But there is a correlation between the extent of surface structures and caribou activities.

Overview of Waterfowl Use

Karen Bollinger of USGS-BRD presented data on molting geese in the Teshekpuk Lake Special Area (Appendix B). The survey area encompassed 199 lakes and Smith Bay, with data for 15 years from 1982 to 1996. Total number of geese varied from 19,000 to 68,000 with an average of 38,000. Molting geese are few in number outside the survey area. The four species present are Canada goose, Pacific black brant, white-fronted goose and snow goose. The total number of all geese using the area over 15 years indicates an increasing trend, primarily due to an increase in white-fronted geese. Of the total Pacific black brant population worldwide, up to 22 percent molt in this area. Snow geese are few, usually less than 500. On average, brant comprise about 46 percent, Canada geese 34 percent and white-fronted geese 19 percent of the molting geese in the area. There are a few breeders, but most are either failed breeders or nonbreeders.

All species use the area northeast of Teshekpuk Lake, with Canada geese and brant sharing several of their highest-use lakes. Brant tend to occur in larger flocks on fewer lakes. Variation is high among years, and the survey is only conducted on one day each July during the peak of molt for all species. On average, eight lakes support 50 percent of the brant; one lake is used by over 3,000. The molt period lasts for about a month and then goose distribution changes. Geese tend to move to coastal areas before leaving the Teshekpuk Lake area entirely.

Brant are an international concern and this area is of high international importance. Birds molting in the Teshekpuk Lake area come from Russia, Alaska and Canada, and winter in Mexico. This area is unique on the North Slope, having large lakes with adjacent meadows, escape cover, and good forage availability.

Oilfield Design Options and Wildlife Mitigation

Mike Joyce, an ARCO biologist, and Ryan Lance, an ARCO engineer, provided their perspective of what practices might be used to protect wildlife while still allowing development.

The greatest problem for caribou is stress from traffic, which has caused all the changes in CAH distribution. This can be mitigated when designing the layout of an oil field and by monitoring caribou movement and stopping traffic when caribou are near the road and about to cross. An oil field in NPR-A would not be the size of Kuparuk and they expect this should work, although there are no data to test this mitigation.

During the three-week calving season, there is avoidance of roads with traffic. Some calving still occurs in the Kuparuk oil field, but the bulk of calving has shifted to the south and west. Following calving, caribou are present on the coastal plain during the insect season. Before there were gravel pads, caribou went to river bars to avoid insects; now they use the gravel pads. Caribou are not

bothered by the presence of a drill rig, the gravel pads, or the pipe. If pipes are built a minimum of five feet above ground and separated from roads, they aren't a problem for caribou during insect season.

The current assumption is that sales-oil pipelines from NPR-A would not have associated roads, but this would have to be decided on a case-by-case basis. Prudhoe and Kuparuk are giant oil fields; there's less than a one percent chance of finding one of that size in northeastern NPR-A. Eventually there could be a threshold number or size of oil fields when roads to the oilfields are less disturbance than the alternatives. In the short term, it is believed roads won't be needed. Rather than using surface vehicles, pipeline spill monitoring can be done daily using forward-looking radar (FLR) from airplanes and detection systems on the line. The FLR can operate from any altitude, if there are no clouds. One trade-off of having no road is that a large-aircraft runway is required in case of a well blow-out. A jet operation would not be necessary, but for oil spill response the capability to land a Herc is required.

Another trade-off is that more space is needed to store equipment that can be brought in only during the winter. Finally, oil field crews change at least once a week. Between that and air transport of supplies, maybe one flight a day would be needed.

For birds, the problem is noise and commotion, which can also be mitigated. ARCO monitors tundra swan nests, which are a prime indicator for long-term information because swans are most sensitive to noise and commotion. Swan numbers have risen rather dramatically in the last three to five years and nesting densities are comparable to historical levels. ARCO has classified habitat into 21 types, and with Geographical Information System software they can better estimate where birds may concentrate during seasonal events and therefore where facilities should be sited to minimize noise and commotion.

ARCO has also been conducting site rehabilitation experiments. NPR-A doesn't have the quality of gravel as found in Prudhoe/Kuparuk; the grain size is smaller. Even thick gravel fill can be rehabilitated if moisture and nutrient cycles are properly addressed. The effects of seeding and fertilizing last only two to three years. With the addition of topsoil and grasses a long-term, sustained vegetative cover can be produced. However, it's a monoculture and slows down the invasion of natural pioneer species. There is a benefit in not developing a monoculture; ARCO has gone to seeding with partial application rates and transplant plugs or seed from natural plants. This provides a more rapid progression to the diverse vegetative community desired.

Collection and disposal of food waste in a way that attracts predators to camp locations can also stress bird nesting activity. Trash is currently placed in dumpsters, transported to landfills, or incinerated. This provides access to food by predators. There are pilot studies on composting at the mess hall in self-enclosed vessels. Composting may be the norm at future camps that will be smaller--50 to 100 people as opposed to thousands at Kuparuk.

(The remaining discussion was directed to questions in Appendix A that had not already been addressed.)

In regard to the question of oil field design and what level of on-site processing would be needed, the size of the oil field at Prudhoe requires six dedicated processing facilities. The Alpine oil field, which is more representative of the potential opportunites in NPR-A, has these same functions and everything else on two pads. Pads in NPR-A would average 8-10 acres each. Considering the tradeoffs, it's best to keep processing close to the wells because multiphase lines have a higher probabilty of spill.

It is hard to predict what type of oil field support infrastructure would be required in NPR-A. It can probably be done a lot more efficiently than Deadhorse. As much as it can, ARCO would try to avoid another Deadhorse in NPR-A.

Two to three years before starting up oil field development there would be a lot of activity that usually occurs during winter. One option for access is building a dock into the Beaufort Sea and barging equipment from Prudhoe or Kuparuk, but

tradeoffs exist. Is a dock better than a seasonal ice road? Are year-round ice pads possible? If so, how much refrigeration is required? Is there another set of environmental problems?

How different drainages would be crossed depends on their characteristics. ARCO will try to cross the Colville by drilling underneath. They contemplate trenching in other places, but not in the Colville. Each drainage has its own set of considerations.

How feasible is horizontal directional drilling? There is a distinction between horizontal drilling and extended-reach drilling. Each is feasible given the right situation. Alpine would have required three or four drill sites in the past; now extended reach drilling will require only two sites. The current record is a reach-to-depth ratio of 4:1. The shallower the oil, the less the reach.

Is an oil field without roads connecting pads feasible? It's technically feasible but not an appropriate tradeoff due to the increased need for local air traffic. With roads, helicopters would be needed only for spill response.

The tradeoff in elevating pipeline eight feet vs. five feet is more expense. Different equipment is needed for construction after about six feet. The extra three feet makes a significant difference in the equipment needed, and thus in costs, but it doesn't make a big difference to caribou. The terrain goes up and down but the pipeline doesn't since rapid topographical changes in the pipe are undesirable, so over 60 percent of the line is well above five feet above the terrain.

Buried pipelines may be feasible and cost-effective, but burial clearly disrupts the tundra. Also, future needs may change, causing the need to dig up and rebury. But foremost is the concern for thaw and freeze of permafrost. Crude oil is hot, and you have to insulate heavily or place the pipe in thaw-stable rock. Pipe can be buried in the road, but it's very expensive and bad from a spill and leak perspective. Also culvert drainage is a difficulty.

Existing DEW-line sites would be given priority for new facilities if they're properly located. However, there is a technical limit to reaching the oil reservoir with the drill.

In general, ARCO wouldn't allow public access to oilfield facilities, but would allow Native subsistence access.

On the question of whether industry would consider sharing seismic data, from ARCO's perspective that would be a big hurdle. Those data are considered a key competitive aspect of the business.

In terms of levels of operations, Alpine will be radically different from Kuparuk; it will have only minimal staff. The technology is not quite there yet to have unmanned sites. Starting in 1998 at Alpine, there will be a lot of activity for two years in winter, with hundreds of people needed then. There would be no impact on animals living there in summer except for drilling. Normal operating mode would need 20 to 40 people.

The economics of completely stopping operations for two to three months are prohibitive in these small fields. A drill rig is not conducive to shutting down in mid-well, nor would it be economic to plan the drilling schedule to stop drilling for two months. There's more to it than just shutting down for two months and not getting two wells drilled. It's dependent on the need to keep the reservoir in balance. Recovery from the field as a whole could be reduced. The optimum would be continuous drilling activity for four or more years. During critical time periods ARCO can try to reduce the number of people. However, ongoing operations are different. If ARCO can figure out how to run with five people rather than 25, it will.

In summary: 1) Complete shut down for the caribou/goose critical period is not economical. People will be present at all times, with a daily commute if their worksite is on a different pad than the camp. 2) Remote operation is not yet technically feasible but has potential for the future. 3) It is not economically feasible to suspend drilling during that period, but minimal staffing and reduced access can be accomplished.

Review of Current Knowledge

Molting geese are flightless and more sensitive to disturbance than during other periods. The Teshekpuk Lake area has been traditionally used by molting and breeding geese for thousands of years (Figure 2). The primary needs of molting geese there are protection from disturbance, available and adequate food supply within close proximity to escape habitat, low predator density, and escape habitat (open water, ice floes). Factors that cause disturbance of waterfowl are predators (including foxes), aircraft overflights, humans on foot, vehicle traffic, noise and commotion. Factors that may affect the availability of an adequate food supply are changing water levels in lakes, developments which restrict goose access to food, habitat loss, contaminants, previous grazing by geese or caribou, nutrient cycling, weather, and overpopulation from lack of predation. Factors that limit escape habitat are weather (influence on ice), topography, hydrology, habitat loss, lake levels (thaw cycle, drainage, modified hydrology, etc.), disturbance, access/proximity (escape has to be near to feeding areas), channelization or drainage patterns (connection of lakes to each other), size of habitat unit, and proximity of lakes to each other. Predator populations are affected by availability of lemmings and other alternative prey species, garbage, supplemental food, human harvest, artificial nesting habitats, number of geese, and disease. Traditional use of lakes by geese may be influenced by habitat modification, population size, frequency of disturbance, and distribution changes.

There are not enough data to say definitively which of the above factors is a higher priority for molting geese, or how some may be related to oil field development. The Prudhoe Bay studies funded by ARCO provided data on 400 to 500 birds, but these may not apply to the thousands of birds at Teshekpuk. A couple of studies have indicated that land traffic per se was not a problem, but people on foot frighten the geese quite a bit. In two brood-rearing areas, one near high traffic and one near low traffic, the high-traffic-area geese reacted less, perhaps suggesting habituation to consistent traffic over time. It may be safe to assume that humans on foot and helicopter traffic are the two most disruptive of anthropogenic factors to molting geese.

Culverts may be a high priority problem, if they cause flooding of an entire goose colony. Indirect effects such as hunter access can be much greater than direct effects, to which birds can habituate. Birds become more wary during nesting. During fall staging for migration, distribution is more related to food than to disturbance.

During work on four species of geese, Steve Murphy ranked disturbance using three criteria: severity of reaction, duration of response, and distance moved. Over five years, he looked at humans on foot, nonpredators, avian predators, ground predators (fox), and aircraft. He investigated the distance at which disturbance seems to drop off. Failed breeders and nonbreeders may respond differently, for example, nonbreeders may spend more energy to get away because they're not tied down by a brood.

Studies by Eric Taylor looked at changes in brant body mass, protein levels, and lipid levels from arrival to departure on the molting grounds. There was a significant protein deficit and decrease in lipids. Brant may select the Teshekpuk area as much for lack of disturbance as for available nutrition. In fact, the nutrition available may not be optimum. Brant molting near Teshekpuk are primarily from the Yukon-Kuskokwim Delta. Almost all lipids are lost during the molt period, down to about two percent. The geese also incur a protein deficit during that time.

Would geese from the Yukon-Kuskokwim Delta react differently than birds born and raised at Prudhoe, where there's already disturbance? Geese react strongly to any disturbance, and there may be a critical time while choosing a place to molt when disturbance will cause geese to move elsewhere.

Some restrictions could be placed on oilfield work during summer to reduce pressure on geese

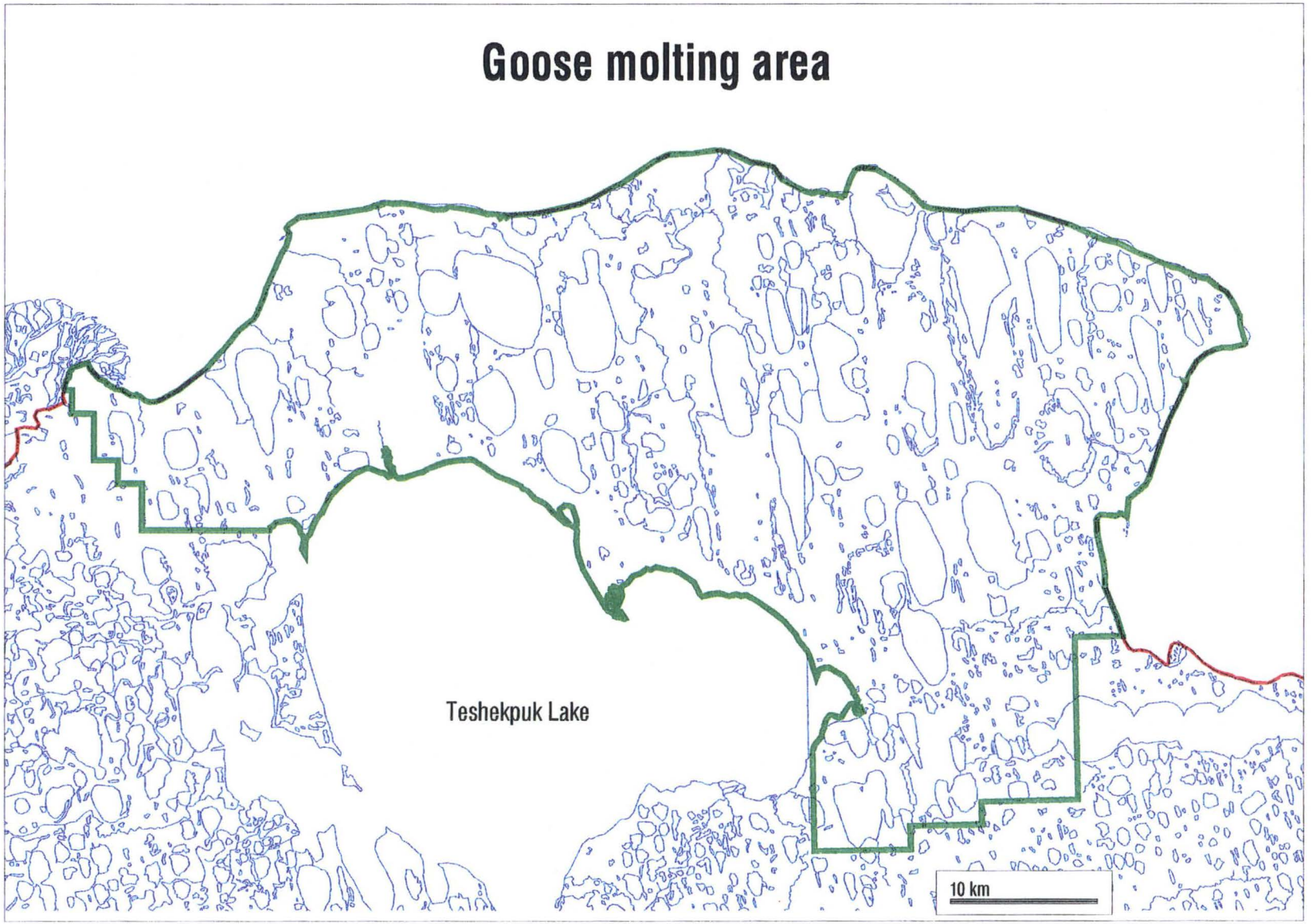

Figure 2. Goose molting area.

while still allowing development to proceed. If ground access was by ice road only, large materials would not be hauled in during the summer, nor would they be flown in by large planes during the sensitive period (mid-June through August). Modules could be flanged up during summer, but all basic construction would take place in winter. If surveyors on foot cause problems to molting geese, they could survey during early spring or late summer to avoid the molting period.

If drilling would be continuous for a few years, there would have to be some transport of people during summer. ARCO accepts access restrictions for large noisy planes and pre-stages heavy equipment and materials before the sensitive period. Air traffic can't be stopped completely, but the number of times a small, relatively quiet plane goes in during the sensitive period may be restricted to perhaps three to four times a week at Alpine. Also, if there is an airstrip, there would be no need for helicopters other than in emergencies. Fixed-wing aircraft are less of a disturbance than helicopters. Also, the frequency of disturbance is important. Taylor's study suggests that the geese have little energetic margin.

Perhaps a "no development" buffer of one to two kilometers could be established around each of the high-use lakes, unless overlapping buffers would preclude development entirely in some areas. If so, perhaps development in those places could be limited to low-disturbance activities. Drilling from outside buffers could possibly reach out 15,000 feet and effectively tap reservoirs. The presence of a cross-country pipeline with no road shouldn't stress birds, so pipelines needn't be excluded from buffer areas.

Development of Stipulations

A draft set of stipulations was introduced to the panel for discussion. The stipulations were based on the following assumptions:

•Geese habituate fairly well to structures.
•Disturbance due to vehicle traffic is mild beyond 200 feet.
•Chronic disturbance due to aircraft is very detrimental and the altitude required to mitigate it is unreasonable given local weather conditions, so the focus should be on limiting frequency and establishing routes of travel.
•Humans on foot are the most disturbing factor.
•Permanent roads that allow access would have detrimental effects in the long term.

Preliminary Ideas Presented for Discussion:

1. Restriction on density of production pads: one per township.
2. No habitat alteration permitted in goose feeding areas.
3. Interfield roads permitted but no road connection to outside road network.
4. Gravel fill for roads would be removed upon completion.
5. All facilities located a minimum of 400 meters from documented-uselakes, as far as possible away, and 2,000 meters from highest-use lakes (use averaged over 15 years).
6. Cross-drainage structures will be sited and maintained so as to prevent impoundment or alteration of hydrology.
7. Material sites not permitted within the molting area.
8. Processing sites shall be preferentially located outside the goose molting area, providing that the multiphase pipeline does not exceed *x* miles. Alternatively, processing facilities shall be located to maximize the distance from the critical lakes.
9. Processing facilities shall not be sited closer than 2*x* to each other.
10. Facility layout shall give maximum consideration to shielding human activity from view of the closest goose molting lake.

Seasonal restrictions on activities, June 15 to August 30 :

11. Helicopter overflights shall be suspended.
12. Routine fixed-wing flights limited to two flights/week.
13. Flight corridors established for designated routes that minimize disturbance to molting geese (generally 3 km lateral from high-use lakes). Use of corridors mandatory, except in

emergency.

14. Off-pad activity shall be prohibited except in emergencies.
15. Construction activities suspended.
16. Road traffic minimized. Transportation of personnel between camps/pad facilities limited to coincide with shift changes. Nonessential operations requiring vehicles other than passenger vehicles shall be suspended.
17. Public access to oil field facilities shall be restricted.

The details of #5 need further work in regard to the width of buffers and the number of lakes to which #5 should apply. Goose feeding areas are typically to the east and west of the lakes, not north and south, so buffers could be adjusted accordingly. It may be difficult to justify the buffer width using only the studies done at Prudhoe. The question remains as to whether those studies apply to the Teshekpuk area, which is unique on the North Slope and may need greater restrictions. However, with the high lake density of the area, larger buffers would effectively eliminate oil development, thus violating one condition of the workshop discussion. The details on buffers (where and how wide) were postponed for the time being.

The use of surface water for oil field development and operation could result in excessive drawdown of lakes. This may result in only a few inches change in the water level, but that change could affect preferred goose feeding areas (Figure 3) along lake margins. These are very flat areas barely above current lake level. A small change in water level could alter the vegetation community present. Also, the activity associated with water removal could disturb geese. For both of these reasons the restriction of surface water extraction would be necessary.

Restrictions on waste disposal should also be implemented. Putrescible garbage needs to be handled and disposed of so that it will not be available to predators. Disposal is not the problem, handling is. Although this is covered under state law, current facilities are not succeeding in this arena. Also, feeding of most wildlife is prohibited by state law but is not adequately enforced. In addition to current law, the feeding of gulls and ravens should be prohibited. Finally, proper planning and training for oil field workers are crucial for avoiding increases in the predator populations.

Fuel storage stipulations would also be helpful. The lakes are in basins, so spilled fuel could drain into the lakes from a long distance. Storage of fuels and all hazardous materials should be restricted to gravel pads. However, fuel is also needed before pads are built. Existing regulations will have to be sufficient in this case.

Increased access because of roads could pose a serious threat to molting geese. Currently, public access is extremely limited and it is important that it remains so. However, regulation of human access on public lands is difficult. Title VIII of the Alaska National Interest Lands Conservation Act doesn't allow anything to occur on federal land that limits subsistence access, unless there is a finding of a significant impact on subsistence and there are public hearings. Ice roads would not be part of this problem, since they do not persist long enough in the spring to provide people with access to molting geese. Gravel roads connected to the highway network or local villages would present a problem. The goal should be to do nothing that would provide increased opportunity for access.

A process must be established to manage subsistence access. A greater effort to work with subsistence users and address these issues would help. Such a process needs to involve the North Slope Borough and local residents. Another facet of this effort might be to have a state and federal monitoring body that would implement studies, conduct integrated planning, find permitting solutions, and promote interagency relationships. This issue of subsistence access would not be appropriate as a stipulation on oil companies.

Closer monitoring of molting goose populations before, during and after development would help measure any impacts and the success of mitigation. Flights once a week to survey goose distribution would not negatively impact the geese, but would provide data on the pattern of their movements.

The draft restriction on the density of production pads to one per township may be unreasonable

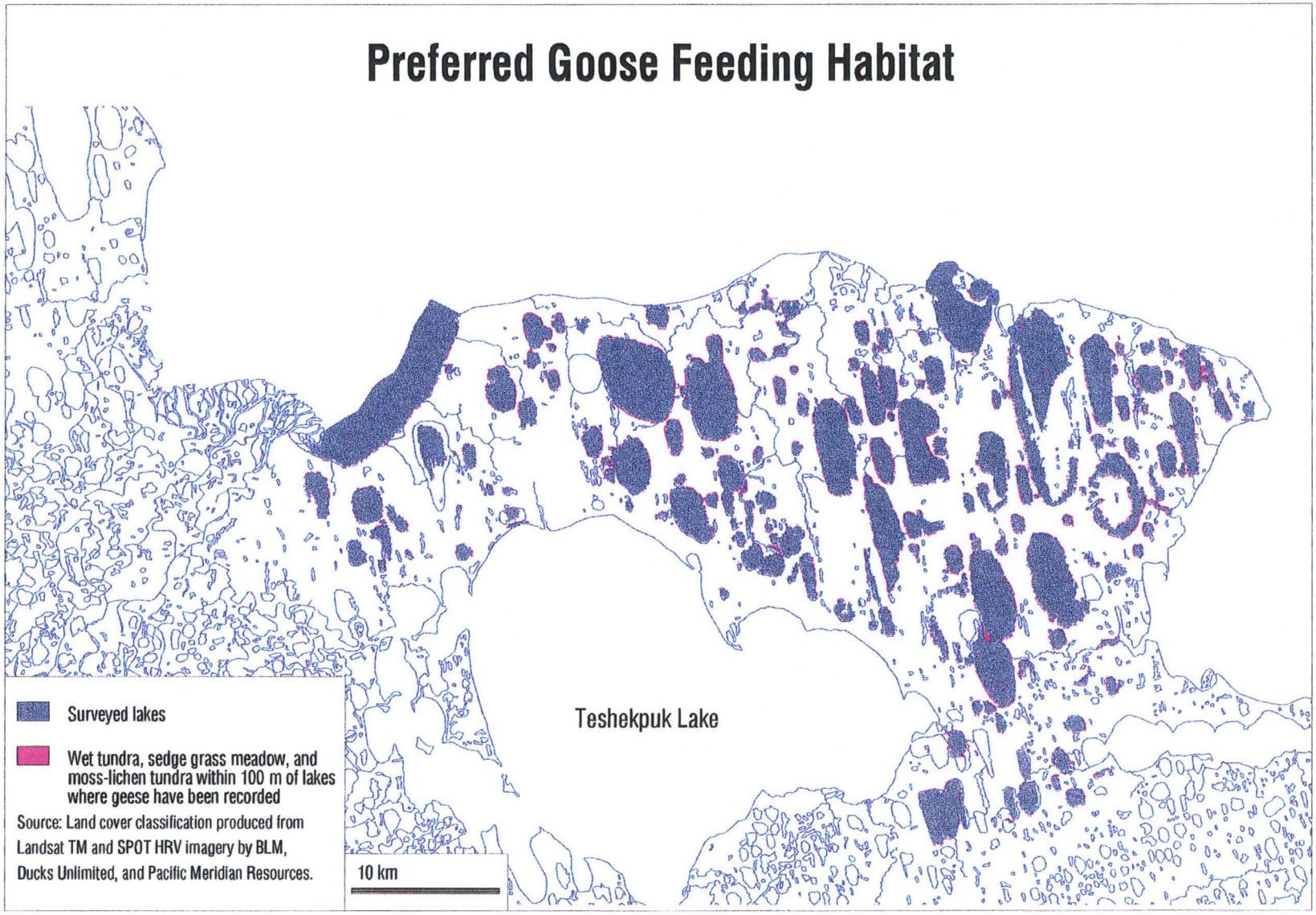

Figure 3. Preferred goose feeding habitat.

from a development standpoint because it isn't possible to reach a whole township from one pad if the oil field is shallow. Would it be better to have one large site or 10 smaller ones? This would be a moot point if there were appropriate buffers that would restrict development to areas where it doesn't impact geese.

No habitat alteration should be permitted in preferred goose feeding areas (Figure 3), which are moss/sedge meadows adjacent to lakes. This type of activity would also be precluded by buffers. Is it better to build ice roads over tundra and avoid the lakes? Meadow habitat is only two to three inches above the lake; is it more sensitive to ice roads? These meadow habitats can be mapped and then stipulations worded so there is no net loss of high-value foraging habitat. Perhaps all exploration and development activities should be prohibited in preferred brant feeding areas.

Gravel intrafield roads should not connect to road networks outside the goose molting area, and gravel fill should be removed, or roads otherwise made unusable, after the life of the field. It isn't enough to avoid connection to existing roads east of the Colville River, since Nuiqsut is west of the Colville. There is concern about future roads, public access and disturbance of molting geese. The general concept is to limit access and consolidate nodes of activity. Road networks should be reduced in size and consolidated as much as possible. It would be preferable to have no roads between oil fields, but only necessary roads within each developed field. Processing and other facilities could contribute directly to goose disturbance as well as to the complexity of the road network, so they should also be consolidated.

Impoundment or alteration of the hydrologic regime could negatively impact both foraging and escape habitats. Cross-drainage structures must be sited and maintained to prevent negative impacts, and properly abandoned once the gravel pad is no longer needed.

Material sites could have adverse impacts on geese both through habitat alteration and disturbance. They should not be permitted within buffer areas, and their operation may be restricted when molting geese are in the area.

Since humans on foot may represent one of the greatest disturbances to molting geese, facility layout must incorporate features that shield human activity from view of the closest goose molting lakes. Fencing on the appropriate sides of gravel pads may meet this need.

Many activities should be restricted while molting geese are present to reduce the disturbance of geese. A decision on the dates of seasonal restrictions was postponed. Helicopters are one of the greatest disturbances to molting geese. Since it has already been established that helicopters are not essential where fixed-wing access exists, helicopter flights should be prohibited seasonally except in emergency.

Off-pad activity could be highly disturbing and should be kept to a minimum. This requirement would be for lease holders only and couldn't be applied to the general public. Since monitoring the geese and other studies would be necessary throughout development and operations, and lessees might be involved, consultation with agencies could be used to determine when these activities would be appropriate. In addition to such studies, off-pad activity during the sensitive period would be allowed in case of emergency.

Construction activities within the seasonal limit could also cause an unacceptable disturbance, but it would depend on the particular job to be done. Therefore construction activities during the goose molt would have to be decided on a case-by-case basis through consultation with agencies.

Road traffic could be reduced during the goose molt by limiting transportation of personnel to coincide with shift changes and suspending nonessential operations requiring vehicles other than passenger vehicles. The reduction of traffic to a very low level could allow for narrower buffers of no roads around lakes.

Draft Stipulations: Waterfowl

1. Exploration and development activities will avoid critical feeding habitat types unless otherwise accepted in consultation with BLM, FWS, NSB, and ADFG.

2. Restrict access via roads or infrastructure by public into molting area.
3. Restrict/minimize/consolidate roads and facilities to the extent possible. Intrafield roads only are preferable. We don't want roads all over the molting area.
4. Road gravel fill removed upon oil field abandonment so that roads are made unusable.
5. Buffers will be added to protect goose molting area.
6. Cross-drainage structures will be sited and maintained and properly abandoned so as to prevent impoundment or alteration of hydrology.
7. Material sites are subject to buffers and seasonal restrictions.
8. Restrict water extraction from lakes used by molting geese.
9. Facility layout shall incorporate features that screen/shield human activity from view of the closest goose molting lake.
10. Putrescible garbage needs to be handled/disposed of such that predators will not have access. Plan so that waste production is minimized.
11. Feeding of any wildlife prohibited.
12. Restrict hazardous materials to existing pads. Standard fuel storage stipulations. See existing regulations.

Seasonal stipulations, about June 15 to August 20 or 30; dates to be determined:

13. Aircraft access minimized. Helicopter overflights suspended except in emergency. Routine fixed-wing flights limited to two round-trip flights per week. Flight corridors established; designated routes that minimize disturbance to waterfowl. Generally 3 km lateral from high-use areas. Use of corridors mandatory except in emergency.
14. Off-pad activity shall be prohibited except in emergencies unless otherwise accepted in consultation with BLM, FWS, NSB, and ADFG.
15. Construction activities suspended unless otherwise accepted in consultation with BLM, FWS, NSB, and ADFG.
16. Road traffic minimized. Transportation of personnel between camps/pad facilities limited to coincide with shift changes. Nonessential operations requiring vehicles other than passenger vehicles shall be suspended.
17. Public access via and use of oil field facilities shall be restricted.

Recommendations

1. Subsistence—process needs to be set up to manage this.
2. Enforcement?
3. Monitoring program on effects of oil development on molting geese, both pre and post. Integrated monitoring team needs to be explored.

Proceedings of the Caribou Panel

Review of Current Knowledge

Importance of the Teshekpuk Lake area to caribou:

The Teshekpuk Lake area (Figure 4) may be important to caribou as a calving ground because of fewer predators, habitat (more micro-relief where snow blows away in winter and provides for certain plant/habitat types and wider feeding options), less human disturbance, and traditional use by the herd. Overall, though, we have little information on the factors that provide good calving habitat.

It is important as a summer use area, including for insect relief and forage, due to its prevailing winds, proximity to the coast and river deltas (more wind, cooler temperatures and later emergence of insects), and for its adequate forage close to insect relief habitat. Caribou need to eat during those portions of the day when insect harassment is not so intense. The TLH ranges primarily within 30 km of the coast when insects are bad. The expenditure of energy to get away from insects, the intake of energy from browsing, and the energy expended traveling to different areas for food are important criteria in defining good insect relief habitat. No portion of the coastal area is known to be used more than others for insect relief. The caribou seem to move northward and westward

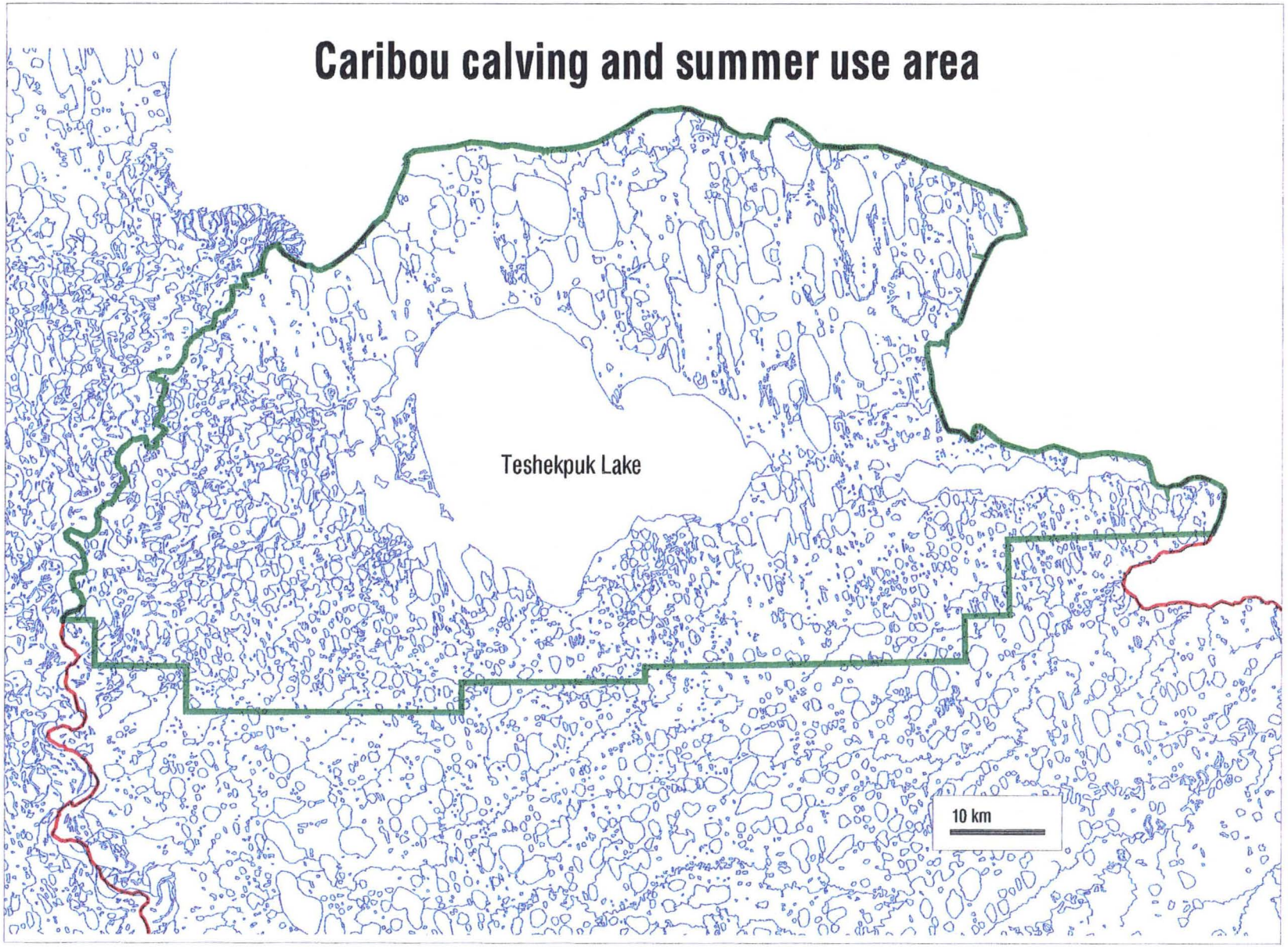

Figure 4. Caribou calving and summer use area.

when insects are bad. As for criteria of good calving habitat, we don't have adequate data on summer forage requirements and availability.

This area is also used year-round by the TLH, in contrast to the Central Arctic Herd, which uses the Kuparuk/Prudhoe area in summer only. Winter use is variable, involving 10 to 100 percent of the herd. There has been a fair amount of winter use between Teshekpuk Lake and Fish Creek, even during severe winter range conditions, which are early winter rains and heavy snow. Caribou that winter in the area get fewer lichens and more sedges in their diet during winter than some other herds in Alaska. The TLH may not be as dependent on lichen forage as other herds, because they have other options.

Recent data show that part of the TLH migrates south of the Brooks Range, but many are still using the Teshekpuk area during the winter. During the late 1970s and early 1980s, it seemed that almost all of TLH wintered in this northern area. However, they didn't have satellite collars then, so we may have had a biased view. Since winter distribution varies, there may be confusion in the future between oil industry effects and weather effects on winter migration.

Another benefit of the Teshekpuk area is the presence of relatively few predators. The prey base is not consistent enough to keep predators in the area year-round. Caribou migratory behavior is erratic and if caribou are not in the area there is nothing else for predators to eat. There may also be more hunting of predators by humans in the Teshekpuk Lake area. Wolves may move into the area temporarily, but they probably do not remain there long-term.

The TLH is the most important caribou herd for local resident hunters. People from Barrow, Wainwright, Nuiqsut, Atqasuk and to a lesser extent Point Lay and Anaktuvuk Pass use these animals. Hunting takes place wherever the people and caribou co-occur. Nuiqsut's use of the TLH is increasing due to summer herd distribution and winter snowmachine travel. As the herd is expanding farther west, Atqasuk is also using it more. Up to 10 percent of the herd is harvested annually for subsistence. Accessibility of the TLH could go up with improved access from oil field activity. Alternatively, it could decrease if developments form a barrier to travel. It is difficult to cross gravel roads with a loaded sledge behind a snowmobile. There are also social barriers: residents don't like oil companies telling them they can't hunt. There are no regulations against hunting around the Kuparuk oil field. At the Alpine field, Nuiqsut and ARCO are negotiating subsistence hunting rules. The Teshekpuk area represents easier access to hunting than the Kuparuk development.

Potential adverse impacts to caribou and habitat:

Impacts on the calving ground could include the actual loss of habitat, the functional loss of calving habitat due to caribou avoiding activity (humans, traffic, etc.), increased predation due to developments attracting predators, and more human disturbance. Within the calving area higher ground is preferred both by caribou and development, so there is a greater potential for affecting habitat. The network effect of development pads near to one another can cause avoidance of an even larger area. The result may be over-crowding on the remaining used habitat. Lastly, aircraft traffic can disturb parturient cows or cows with calves.

Development in the summer use area could impede movement along the coast and between foraging and insect relief habitats and interrupt use of insect relief habitat. However, gravel pads could also provide relief from insects. The use of manmade structures by caribou during insect season may or may not result in less efficient feeding. Caribou could also be killed in collisions with vehicles. The cumulativeness of impacts is important; if insect relief and access to forage are affected, there may be a cumulative energetic cost. As more impediments are introduced, the cost may increase to a threshold where productivity and survival are significantly reduced.

Year-round use of the area could also be affected. Disturbance could cause caribou to move around more in winter, increasing energetic costs and possibly functional habitat loss. The degree of

separation between pipelines and roads can influence the accumulation of snow in drifts that create barriers to caribou. Roads by themselves can also produce snow drifts. There would be more aircraft disturbance in winter, since more and larger aircraft are used then. Because caribou are there year-round, there is more potential for hunting.

Discussion of impacts and studies from existing developments

Might caribou that see traffic during winter subsequently avoid a road during the calving period, even if traffic is prohibited then? No evidence of behavioral reaction to the roads themselves has been documented. There are cases where studies have shown caribou calving very near gravel pads, but it's a small number of animals. They tend to be in areas where there is much less activity, and relatively near operating drill sites that have very low traffic rates. Disturbance effects have been most noticed in and around major trunk roads with higher traffic rates. In the western part of the Kuparuk field, in an area of very little traffic, one pass of a truck has been sufficient to send cows and calves running pell-mell for a half-mile. So even a little traffic may be enough to elicit that behavioral response. The result is displacement of cows and calves from areas near roads. Mitigation for this has not been tested.

There is no way to avoid the behavioral sensitivity of cows and young calves to activity, so the activity should be constrained or reduced. If the desired condition is to totally avoid behavioral effects along a road, then allow no vehicle traffic during calving season. This extreme case has never been stipulated nor its effects tested. There has been too much resistance by oil field contractors and subcontractors.

How can disturbance be eliminated or reduced in an area? As a partial solution, the BLM could require unitization of fields. In state (Alaska) oil and gas lease sales, consolidation of facilities is one of the stipulations. If NPR-A development goes according to the geological scenario (one-to-a-few small oil fields), one small field could cross boundaries of tracts owned by different bidders. On state land there are companies leasing side by side, and when they unitize the field they choose one company to operate it. Depending on how BLM structures its regulations, it could have the same situation. There could be stipulations to minimize the number of facilities, such as airports.

The major oil fields on the North Slope have all been unitized, but each has been developed separately. There hasn't been a requirement that Prudhoe and Kuparuk be developed as one field. Geologically they are separate. The question becomes: should several oil fields share the same airport and other facilities? If there are dispersed fields without interconnecting roads, it would be difficult to have one airport servicing all fields. If there is no road, an airstrip is needed at least for emergency response but probably for crew changes and supplies also. But one saltwater treatment plant could serve several fields.

In terms of restricting activity, an oil field can't be shut down during calving. It's not feasible from a safety consideration, if nothing else. Currently, oil companies have a two-weeks-on, two-off work period. Would a six-week period during calving with no crew changes be reasonable? Could there be fewer grocery deliveries and less fresh food to reduce aircraft activity?

This would reduce air traffic only, because people are not going to live at all drill sites. If an oil field requires more than one pad, there has to be traffic. Completely shutting down an oil field is not an option, so neither is having no traffic at all. Perhaps during the six-week calving period traffic could be restricted to convoys at the beginning of each shift change.

How effective might monitoring caribou and controlling traffic be during calving season? There will still be traffic when caribou are not approaching the road, and cows may see the traffic and avoid that area. It might be reasonable mitigation during the summer use/insect relief period, but perhaps not effective during calving season. An option for mitigation during calving is to design an oil field to restrict the area and extent of activity, i.e., minimal number of pads, minimal length of roads, and minimal traffic. But these restrictions

would also be tempered by economic concerns. The economics of these smaller fields drives what can be considered in designing them.

During the summer following calving, it would be beneficial to restrict traffic to ≤15 vehicles per hour. In the past, minimizing unnecessary traffic has been stipulated but difficult to enforce. In a sensitive area like that around Teshekpuk Lake, where large aggregations of caribou might move through an oil field, caribou monitoring and subsequent traffic control may be a more effective and responsive approach than broad-scale seasonal restrictions. If the general location of caribou is tracked, there will be days when they won't be in an area and gravel hauling or other heavy traffic could be allowed.

A different problem could be hunting from the road. One recommendation stressed by Cronin, et al. (1994), was a strict prohibition on vehicle-based hunting. As soon as caribou associate roads with hunting, they will avoid them. Hunting from the road by oil field employees can be prohibited. That can also be regulated by the Federal Subsistence Board and the Board of Game. The law already prohibits shooting from or along the driveable surface of any road, but all one has to do is literally step off the shoulder, shoot at an angle away from the road, and it's legal. In the Swanson River oil field, USFWS has a hunting stipulation that does not allow people to use vehicles within the field. Hunters can go into the field on foot and hunt but can't take a vehicle. For NPR-A, a recommendation for no hunting could be made to the Board of Game because hunting exacerbates the whole caribou disturbance issue.

The reaction of caribou to pipelines may be influenced by height, number of pipes on a rack, and separation from roads. Five feet between the ground and the bottom of the pipe at vertical support members (VSMs) appears to be a good height for an elevated pipeline. There are places over high terrain where the pipeline would be close to the ground, which may impede caribou movement. However, 60 percent of the Alpine pipeline will be above five feet because of the uneveness of the terrain. There are no data to suggest that caribou benefit from having the pipeline six feet high or higher. On the Endicott development, biologists found no selection for higher pipes by caribou. The frequency of strong reactions by caribou to elevated pipe has decreased over the years. There were some by the CAH early on, so there may be a learning curve for a herd that has never experienced elevated pipeline.

Some question remains about the relative effectiveness of ramps over pipe vs. sections of extra-high pipe (eight feet) in areas identified as crossing locations. The latter has never been tested as an alternative, but there have been several studies of ramps. They have been used more frequently than expected in relation to their availability, but that may be a function of their extremely narrow width. Statistically, almost any use of those ramps, which represent a very small proportion of pipeline length, translates to significantly above-average use. In terms of getting large caribou groups over pipes, the only place where ramps were effective was in the Prudhoe field where some pipelines are much lower than five feet. The general conclusion is that elevated pipeline alone is sufficient without stipulating ramps.

There is less experience with the evaluation of pipeline/road separations. There has been one dedicated study of that, but it was in a year of little mosquito activity so it was less conclusive than desired. Nonetheless, the initial indications were that the separation of pipelines from roads by ≥100 meters resulted in significantly more frequent crossings. This separates two elements of a development corridor (road and pipe) that appear to have synergistic effects.

Another consideration is on which side of the road should a pipeline be placed. In the Kuparak field, when caribou encounter the pipeline first they often hesitate at the pipeline. While hestitating, traffic would come by and cause further delay or deflection.

A study in the Kuparak field in the late 1980s addressed the number of pipes on a rack, separate adjacent sets of pipes on racks, and caribou crossings. Normally, caribou crossing success has been evaluated by looking at whether or not caribou

approaching at a certain distance succeeded in getting through to the other side. The Kuparak study involved more behavioral monitoring and group sampling. At one place in Kuparak, there is one rack with several pipes on the south side of a road, another rack with several pipes on the north side of the road, and yet a third rack beside that. There are now caribou trails running parallel under those wide racks of pipes. Ruts are being formed in those shaded areas under the pipes, which provide fly relief habitat. Indications are that it's more difficult for caribou to cross under the pipes from one side to the other, but the data do not test this.

A possible mitigation would be to bury pipes under the roads, which has been done in the Milne Point field. The effects of that on caribou hasn't been studied, but it makes sense from the standpoint of mitigating potential delays or deflections of caribou crossings in corridors where pipe must be adjacent to the road. However, it requires more gravel, a larger area of natural vegetation must be buried, and oil spill detection is more difficult.

The average roadpad thickness is five feet. Would a three-foot roadpad be easier to cross? Sides of roads are ramped; the problem is not the physical barrier, but the visual barrier. Caribou are more apprehensive if the road is the same height as the pipeline and they can't see the other side. It also depends on the visual topography of the area. However, technological constraints may require that five-foot thickness for load-bearing capability. The problem can be partially mitigated by separating pipeline from road.

Layout of the field (whether pipes or roads run north-south or east-west) could also make a difference. Caribou movements show directional trends. Roads and pipe could be oriented in relation to the principal direction of travel by caribou groups moving to and from the coast. In parts of the Endicott corridor, caribou can still reach insect-relief habitat without needing to cross the pipeline. In the Teshekpuk area, caribou movement is much more restricted by the number and distribution of lakes. Except along the coast, movements are mostly north-south and there are caribou trails that seem to be used with great regularity. It would make sense to be aware of that and design any development accordingly. This is especially so between Teshekpuk Lake and the Kogru River, which create a natural funnel the entire herd must go through every year. Here it may be necessary to bury pipelines under roads, or even prohibit all potential barriers to movement in that area. Some lessons on caribou movement have been learned the hard way over the years in the Kuparak field. There, corraling effects of roads and pipelines created some of the worst examples of delayed and deflected movement. Loops, circles and similar designs must be avoided.

In general, mitigation studies have focused most on the insect and calving seasons. The largest concern may be the calving season. But for the Teshekpuk area, on-the-ground studies are needed to see how caribou use the area in all seasons. Such studies could be stipulated in lease agreements.

Development of Stipulations

Because caribou movement along the Beaufort Sea coast is crucial for insect relief, it would be best to establish a zone of no unnecessary permanent surface occupancy (permanent facilities) within two miles of the coastline (Figure 5). A similar stipulation was proposed for the Arctic National Wildlife Refuge during past planning efforts. Some facilities, such as seawater treatment plants, may be necessary in that zone. A needs assessment would have to be done for each proposed facility. During cumulative impacts analyses, future actions such as state offshore lease sales would have to be considered. Since establishment of this zone would push development inland from the coast, would it force development into areas that are even more sensitive? Probably not for caribou, but it may cause conflicts with the needs of molting geese.

The roughly 10-mile-wide strip between Teshekpuk Lake and Harrison Bay, and especially the corridor between the lake and Kogru River, represents an area critical for caribou movement. There are large caribou trails in this area. Another such area lies northwest of the lake, between it and

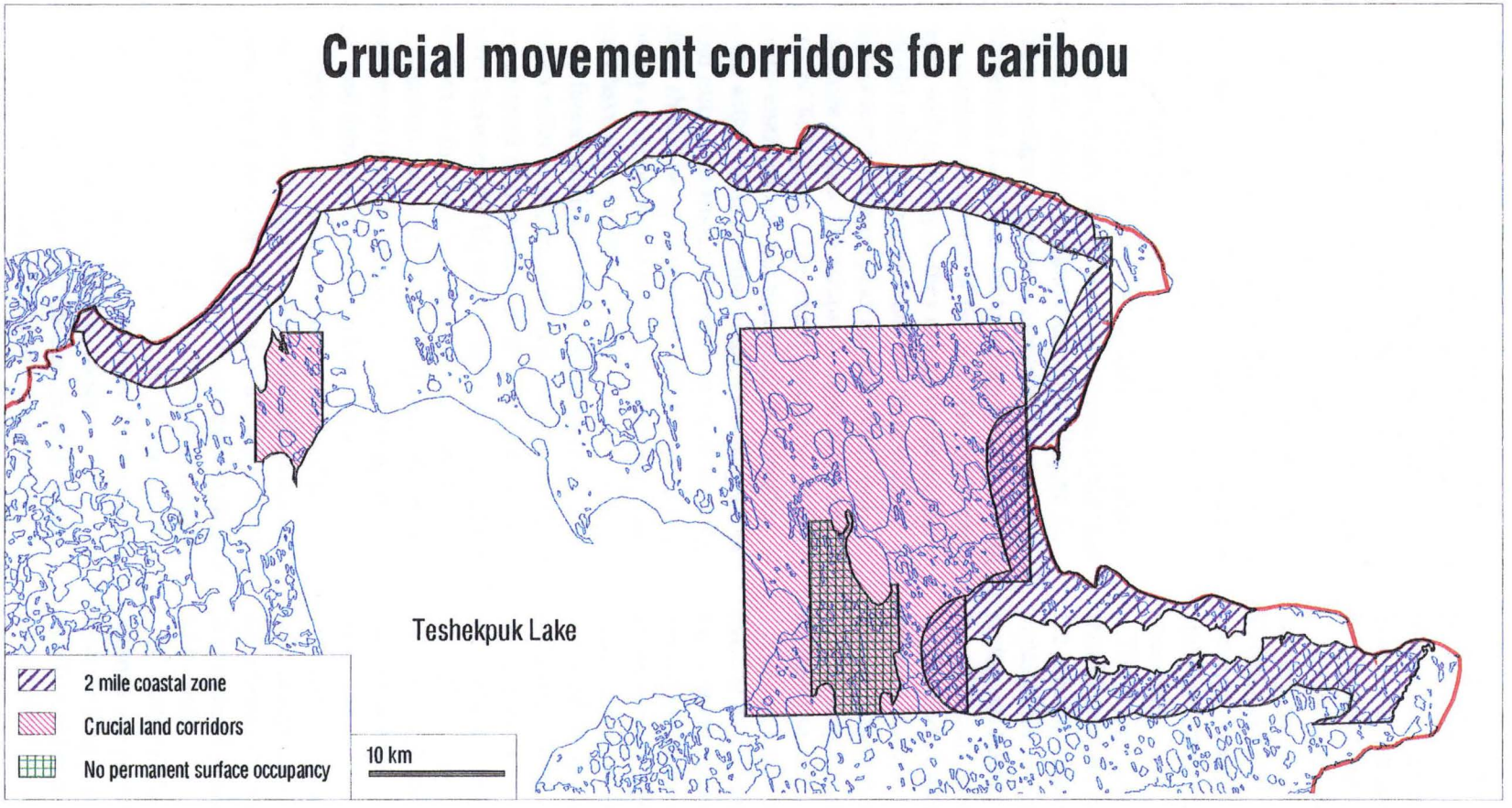

Figure 5. Crucial movement corridors for caribou.

Smith Bay. If oil is discovered in these areas, development should be designed so it would follow the direction of caribou movement and not impede movement in any of these corridors. Perhaps a general stipulation should be included saying that special requirements and greater scrutiny may be imposed on development in areas critical to caribou movement. Also, some facilities may have to be constructed outside the boundaries of the lease that contains an oil discovery, if a critical movement area is involved.

It is easier at this time to designate townships that encompass these movement areas, rather than trying to identify particular corridors (Figure 5). Six townships cover the majority of the area east of Teshekpuk Lake and one township is sufficient for the corridor northwest of the lake. The BLM can work with industry as they design facilities, but should make it clear up front that there will be tighter restrictions on placement of roads and facilities in those townships. In most of the area east of Teshekpuk Lake, roads should run in a north-south pattern, not east-west. In a smaller zone within those six townships, extending about four miles east from the eastern shore of the lake, there should be no permanent surface occupancy. In any of these critical movement areas pipelines may have to be buried.

To further mitigate impacts in summer use and insect relief areas, any elevated pipeline should be a minimum of five feet high at each VSM, measured between the highest point of ground and the bottom of the pipe. To reduce the number of production pads and the resulting network effect, maximum feasible extended-reach drilling should be used throughout the Teshekpuk area.

Pipelines and roads should be separated to reduce their synergistic effects on caribou movement. The greater the separation, the better it is for the caribou. Benefits of separation begin to show at 300 feet and improve out to 1,000 feet. If a strict minimum is set, the BLM may get into a corner later if the minimum is not feasible. For instance, topography may be a limiting factor.

Which side of the road the pipe is on may also contribute to the success of caribou movement. In some places caribou come from all directions, but in other places there is one direction used more frequently. This may require additional studies. For now it may be adequate to state that pipelines must be placed on the appropriate side of the road.

To reduce the disturbance by vehicular traffic on calving grounds and the summer use area around Teshekpuk Lake, traffic restrictions could include convoys, busing, caribou movement monitoring, and controlling traffic when caribou crossings are imminent.

The design and layout of oil field development should conform to caribou movement patterns to the greatest extent feasible. Planners should consider the orientation of linear corridors when laying out fields to address caribou migration and the potential corralling effect of gravel pad networks, and to avoid loops of road and pipeline that connect facilities. Such design planning would require greater knowledge of caribou movements. Studies may be required, including mapping of caribou use areas.

Just one study would not be sufficient, because caribou may change their movements in reaction to existing structures. As soon as a lessee makes a discovery, they could begin studies. However, the lessee would be designing the field right after discovery, so with this scenario the design would be based on one summer's study at best. Thorough biological studies of caribou movements and use of the area should be conducted immediately after oil and gas leases are awarded and prior to development plan design, to determine how to best locate facilities. The lessees should fund these studies through a joint state/federal/borough oversight committee.

To reduce the total number of gravel pads in a field design, all facilities except airstrips, docks and seawater treatment plants should be located on drill pads. If possible, airstrips should be integrated with roads.

To further reduce disturbance during calving and summer use periods, no seismic activity or exploratory drilling should take place in the Teshekpuk area from May 1 through September 30. Helicopters could also represent a disturbance factor at this time, but there are no data documenting their

impact on caribou. Since the waterfowl panel will undoubtedly address this issue, it can be deferred to them. Also discussed but deferred are prohibitions on all construction between May 1 and June 15, and on the construction of permanent roads connecting individual fields to each other or to the road system outside NPR-A.

In small operations, it is likely there would be two or three pads connected, but only one camp. How much traffic is involved with the operation depends on the stage of development. The number of drilling operations drops off as the field matures, but maintenance continues. It would be desirable to have no traffic during calving, but given the economic reality, keeping it to a minimum would be the best possible action. This could be accomplished in part from May 20 through June 20 by limiting traffic to four convoy round trips per day between facilities. It could be further improved if drilling muds and other major equipment, materials and supplies were moved and stored at work sites at times different than the calving season, i.e. prior to and after May 20 through June 20.

The size and speed of vehicles and the size of dust plumes they produce should also be limited. Speed limits from May 20 through June 20 could be minimized to the point where no dust plumes are produced and caribou behavior is not impacted by the sight of large, speeding objects. Perhaps a convoy could be led by a water truck to hold down dust. However, it would probably be more practical just to require that traffic speed be reduced to 15 mph from May 20 through June 20.

Traffic is not the only disturbance factor that can cause parturient cows or cows with calves to avoid roaded areas. The association of hunters with roads can have the same effect. Hunting by all oil field workers should be prohibited.

Fixed-wing aircraft can also disturb calving caribou. Since Twin Otter aircraft are currently found sufficient for normal operations, it should be required that between May 20 and June 20 the use of aircraft larger than a Twin Otter be for emergency purposes only. Aircraft traffic takeoffs and landings should be limited to an average of one flight a day between May 20 and June 20 at aircraft facilities, except for emergencies.

Caribou calf survival can be affected by oil field development if predators are attracted to the area. Putrescible waste disposal should be conducted so as to not attract calf predators. Possible methods for implementing this include bear-proof dumpsters, fenced camps, incineration, backhaul, or enclosed compost.

Draft Stipulations: Caribou

1. Any elevated pipeline will be a minimum of five feet high at VSMs, measured at VSM between highest point of ground and bottom of pipe.
2. There will be a potential for ramps, buried pipe, or pipe buried under the road where facilities or terrain funnel caribou movement.
3. Separate elevated pipeline/roads by 500 feet minimum, if feasible.
4. Place the pipeline on the appropriate side of the road to prevent delay or deflection of caribou, depending on caribou movement.
5. Traffic restrictions may include:
   - convoying
   - busing
   - caribou movement monitoring, and
   - controlling traffic when caribou crossings are imminent.
6. Consider orientation of linear corridors when laying out fields to address migration, corralling effect, and avoiding loops of road and/or pipeline that connect facilities.
7. Biological studies of caribou movements and use of area will be conducted prior to development plan design, to determine how to best locate facilities. Lessees will fund these studies through a joint state/federal/borough oversight committee immediately after the leases are awarded.
8. There will be a zone within two miles of the Beaufort Sea coastline that will allow only necessary permanent surface occupancy. Examples of necessary will include:
   a. a staging area or causeway that requires a year-round road to the inland area,
   b. a seawater treatment plant and associated

pipeline or road, or

c. a production pad for an oil field that cannot be produced from outside the two-mile zone.

Examples of unnecessary are:

a. airports,

b. camps, and

c. some processing facilities.

The burden of proof as to necessity is with the lessee.

9. Use maximum feasible extended-reach drilling for production drilling.
10. No seismic activity or exploratory drilling from May 1 through September 30.
11. Road traffic from May 20 through June 20 will be minimized (a reasonable target would be four convoy round trips per day between facilities).
12. From May 20 through June 20, traffic speed will be reduced to 15 mph.
13. Major equipment, materials, and supplies will be stockpiled at work site prior to and after May 20 through June 20 to minimize road traffic.
14. Use of aircraft larger than a Twin Otter between May 20 and June 20 will be for emergency purposes only.
15. Aircraft traffic takeoffs and landings will be limited to an average of one flight a day between May 20 and June 20 at aircraft facilities, except for emergencies.
16. Hunting by all oil field workers is prohibited.
17. All facilities except airstrips, docks, and seawater treatment plants will be located on drill pads.
18. If possible, airstrips will be integrated with roads.
19. Putrescible waste disposal will not attract calf predators, by using, for example, bear-proof dumpsters, fenced camps, incinerators, backhaul, or enclosed compost.
20. A north-south corridor between Teshekpuk Lake and Kogru Inlet is a crucial area for caribou movement.
    - buried pipeline
    - zone of no permanent surface occupancy extending four miles east from eastern shore of Teshekpuk Lake.
21. Within the designated crucial areas—the movement corridors to the east and northwest of Teshekpuk Lake—facilities placement will receive greater scrutiny.
22. Encourage off-lease site development in crucial areas.

Group Review and Synthesis of Stipulations

Review of Stipulations

Caribou Stipulations:

Both panels reconvened as one group and reviewed the 22 draft stipulations for caribou. There was a concern that the height requirement for pipelines in #1 didn't specifically address human (and snowmobile) passage under pipelines. However, this was a subsistence issue and fell outside the purview of this workshop.

The third stipulation contained a minimum distance for separation between pipelines and roads, but did not specify a maximum distance. This could be a concern if the only method of spill monitoring was visual inspection from a road-based vehicle. However, with the capability of aircraft-mounted radar for spill monitoring there would be no reason to specify a maximum distance.

The two-mile coastal buffer referred to in #8 is an area in which the panel would prefer to see absolutely no development. Since that may not be feasible under an EIS alternative that allows leasing in the entire area, this stipulation was developed so that the oil industry would understand that any development plans in that zone would be under greater scrutiny.

The requirement for maximum feasible extended-reach drilling in #9 was not tied to a specific area. It was intended to cover the entire area addressed by this workshop.

The intent of #13 was to minimize traffic during that one-month period of May 20 throught June 20.

Waterfowl Stipulations:

The buffers referred to in #5 were intended to exclude all permanent facilities except pipelines.

The features implied in #9 to screen the view from geese were snow fences or something similar. The restriction described in #11 was meant to apply to all animals, including gulls and ravens, which are not covered under existing law.

The restrictions on public access in #2 and #17, and on roads in #3, were developed so that new facilities would not provide additional access for the public. One concern was that people might boat to a facility and then use the facility's road system to get to other areas. However, a road between fields might be less disturbance overall than separate facilities for each small oilfield.

There was considerable discomfort among the group regarding how vague both sets of stipulations were on just how extensive a road network might be built in the Teshekpuk Lake area. It was obliquely referenced in #7 of the caribou stipulations. Could that be expanded to say "roads in this area will not be connected together to the extent possible"? If #3 of the waterfowl stipulations was changed to remove "molting" so that it would apply as well to the entire caribou area, it might be the best that could be done without knowing where and what types of development would be needed.

Resolution of Conflicts Between the Sets of Stipulations:

There was concern that #1 and #5 of the waterfowl stipulations might push development into areas that are critical to caribou. The specific habitat addressed in waterfowl #1 is immediately adjacent to lakes. Both #1 and #5 of the waterfowl stipulations need additional GIS analysis to delineate those areas in the document. There may not be an actual conflict.

Waterfowl #2 was eliminated since it was covered by #17. Waterfowl #16 limits vehicle traffic to two shift changes per day, whereas the caribou panel suggested no more than four round trip convoys each day. These two stipulations address two time periods that barely overlap. During the overlap period the more restrictive should apply. The same could be done for seasonal restrictions on fixed-wing aircraft where they overlap in time and area.

Does the restriction on helicopter flights in waterfowl stipulation #13 mean that no wildlife surveys could be done by helicopter during that time? These stipulations would apply only to oil and gas lessees, not to agencies. However, there might be the impression of an unfair double standard; agencies should coordinate better in the future to ensure that helicopter flights during that period are the minimum necessary for mission accomplishment.

A better definition of prohibited construction activities should be included in waterfowl #15. It was meant to limit construction activities using heavy equipment. Drilling rigs should be excluded from the definition of heavy equipment.

Residual Impacts

The final goal of the workshop was to determine what the residual impacts to wildlife would be, given the application of the above stipulations. However, this question could not be resolved because there was not adequate quantitative information for either caribou or molting geese. Residual impacts could only be described in a qualitative manner.

Since there is practically zero tolerance for human activity in a caribou calving area, the result of any development would be some displacement of calving caribou. The extent of this cannot currently be quantified and it is unknown if it would translate into population loss. There are recent data from the CAH that suggest that it might.

Neither the number of molting geese that might be displaced nor the energetic costs of that displacement can be estimated. In general, the result of development would be the disruption of caribou movements, some localized displacement of molting geese and calving caribou, and some harassment of caribou and geese. Finally, given the lack of energetic tolerances, there would likely be energetic stress, increased mortality and decreased productivity in caribou and geese.

Buffer Widths for Goose Molting Lakes

On May 28, 1997, Philip Martin, Anne Morkill, Jack Winters, Dave Yokel and BLM's GIS specialist Tim Hammond met to discuss the buffers around lakes used by molting geese. Several assumptions and guidelines were first established:

- Pipelines within buffers would not negatively impact molting geese.
- Goose foraging habitat extends up to 100 m from lake edges.
- The disturbance effect of vehicle traffic lessens at distances over 400 m.
- No study has shown a lessening of the disturbance effect of foot traffic at distance. This phenomenon has not been studied at distances greater than 1000 m, although some anecdotal observations have been made during other studies.

Using GIS technology, several options for buffers were investigated with the goals of providing geese adequate protection based on the above assumptions while still allowing the development of any discovered oil fields. The most reasonable solution found for satisfying both goals was a two-step approach (Figure 6). A 500 m buffer would be established around all goose molting lakes. Only pipelines would be allowed within that buffer. In addition, a 1000 m buffer would be established around those lakes that cumulatively account for at least 80% of the molting brant, and 50% of each of the other three species. Within the area between 500 m and 1000 m of these lakes, roads and production-only pads would be allowed, but all other facilities, including airstrips, would not. By the above goose population percentage criteria, this additional buffer was applied to 40 lakes that account for 83% of the brant, 69% of the Canada geese, 58% of the greater white-fronted geese, 75% of the snow geese and 73% of all geese combined.

Since it was recognized that these stipulations might preclude the development of some oil fields, depending on their location, depth and orientation, it was decided to include the provision that in such a situation exceptions might be made by the BLM in consultation with the USFWS.

Development of a Combined Set of Stipulations

On June 2, 1997, a teleconference to merge the caribou and waterfowl stipulations was attended by panelists Jim Craig, Joe Dygas, Don Hansen, Philip Martin, Anne Morkill, Tom Rothe, Dick Shideler, Jack Winters and Dave Yokel. Also participating were workshop attendees Phyllis Casey, Marie Crosley, Jim Ducker, Johanna Munson, Mark Myers, Dick Roberts, Pam Rogers and Curt Wilson. Each of the two sets of stipulations were separated into categories (see below) to expedite comparisons. A single set of stipulations with no redundancy and presumably no contradictions was developed from these. This list represents the final recommendations of the workshop panelists to the BLM for the management of oil and gas development in the Teshekpuk Lake area, should it occur.

The area that encompasses the caribou calving and summer use areas is larger than, and includes in its entirety, the area that encompasses the lakes used by molting geese. If any of the stipulations listed below is meant for the goose area only, it is so noted. Those stipulations that are meant to protect caribou may in some cases increase the potential impacts to molting geese, and vice versa. This cannot be ascertained until the design plans for a specific development project are drafted, which won't take place unless an economically developable oil field is discovered in the future. At that time the BLM, in consultation with the USFWS, shall decide how to resolve any conflict between two or more stipulations.

Final Workshop Stipulations

Biological Studies:

1. Immediately after leases are awarded, to allow completion prior to development plan design, conduct studies of caribou movements and use of the area to determine how to best locate facilities. Lessees shall fund these studies in

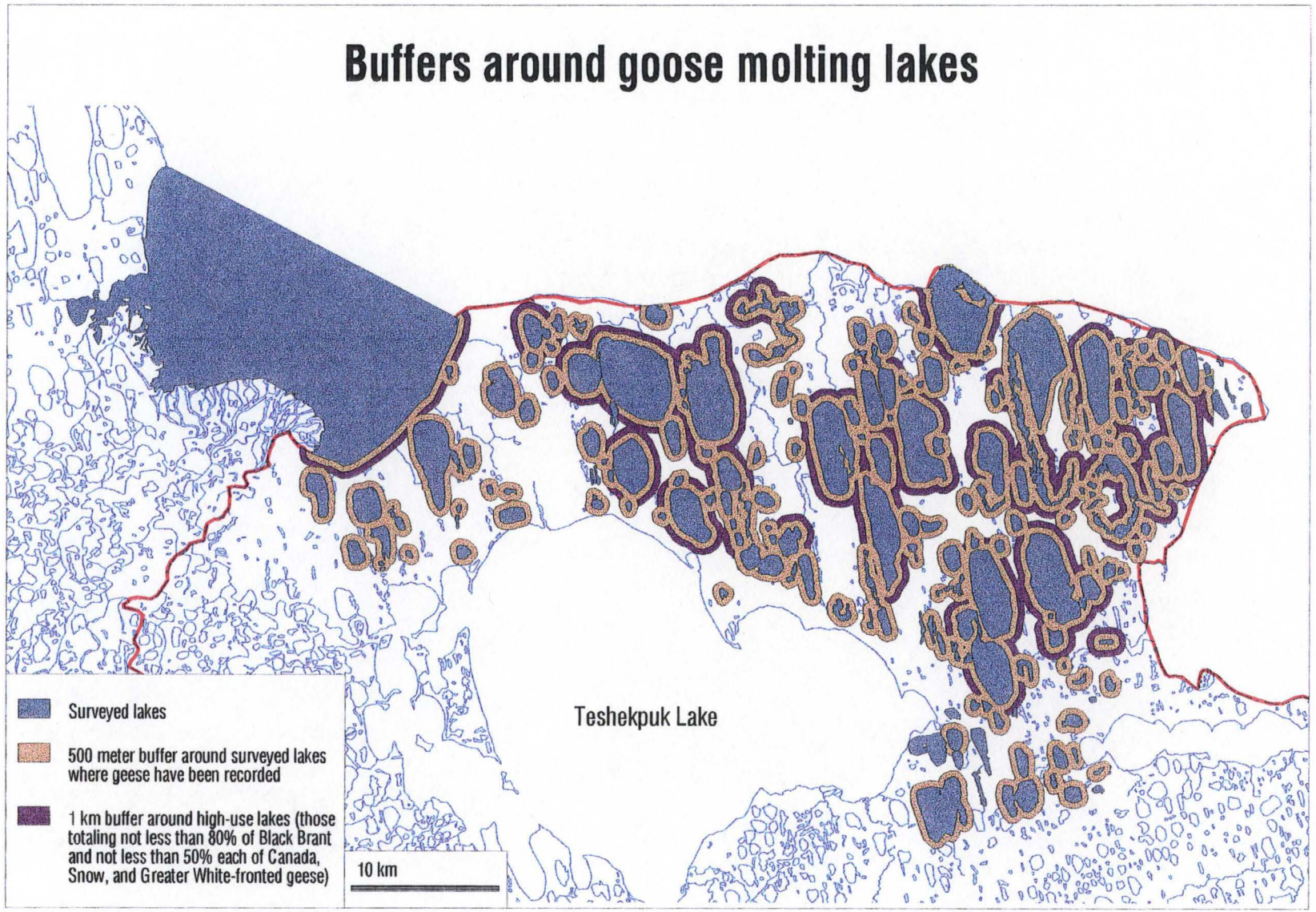

Figure 6. Buffers around goose molting areas.

be designed and the ensuing work awarded through a joint state/federal/borough oversight committee.

Oil Field Design:

2. All goose molting lakes (Figure 6) shall have buffer zones of 500 m surrounding the lakes. Within these buffers no permanent structures, excluding pipelines (e.g., roads, pads, airstrips, material sites), shall be located. High use lakes (Figure 6) shall have a 1,000 m buffer zone within which no permanent structures, excluding pipelines, shall be located. If the above restrictions preclude development, exceptions shall be made by the BLM in consultation with the USFWS. Exceptions may also be granted if other alternatives are demonstrated environmentally preferable.

3. There will be a zone within two miles of the Beaufort Sea coastline (Figure 5) in which only necessary permanent surface occupancy will be permitted. Examples of necessary include, but are not limited to: 1) a staging area or causeway that requires a year-round road to the inland area; 2) a seawater treatment plant and associated pipeline or road; 3) a production pad for an oilfield that cannot be produced from outside the two-mile zone. Examples of unnecessary are: 1) airports, 2) camps, and 3) some processing facilities. The burden of proof as to necessity is with the lessee when a development plan is submitted to the BLM.

4. There are two narrow land corridors between Teshekpuk Lake and the Beaufort Sea (northwest and east of the lake; Figure 5) that are crucial caribou movement corridors. Within these two areas:
    a. Facilities placement will receive greater scrutiny by BLM during development plan design.
    b. Off-lease site development would be encouraged if it would reduce development within a crucial area.
    c. Burial of pipelines may be required.
    d. There will be a zone of no permanent surface occupancy extending four miles east from the eastern shore of Teshekpuk Lake in the area between the lake and Kogru Inlet.

5. Use maximum feasible extended-reach drilling for production drilling to minimize number of pads and the network of roads between pads.

6. All facilities except airstrips, docks and seawater treatment plants will be co-located with drill pads. Exceptions may be granted or required by the BLM, in consultation with the USFWS, if a development is permitted within 1000 m of a high-use goose lake.

7. If possible, airstrips will be integrated with roads.

8. Orient linear corridors when laying out fields to address migration and corralling effects, and to avoid loops of road and/or pipeline that connect facilities.

9. Exploration and development activities will avoid alteration of critical goose feeding habitats (grass/sedge/moss) along lakeshore margins (Figure 3).

10. Facility layout shall incorporate features (e.g., temporary fences, siting/orientation) that screen/shield human activity from view of any goose molting lake within 3 km.

11. Cross-drainage structures will be sited, maintained, and properly abandoned to prevent impoundments or alteration of local or areawide hydrology.

12. Any elevated pipeline will be a minimum of 5 ft high at VSMs, measured at VSM between highest point of ground and bottom of pipe.

13. Ramps, buried pipe, or pipe buried under the road may be required where facilities or terrain funnel caribou movement.

14. Separate elevated pipeline from roads by 500 ft minimum, if feasible. Examples of where it might not be feasible: narrow land corridor between lakes; and where pipe and road converge on a drill pad.

15. Place the pipeline on the appropriate side of the road (depends on general caribou movement in that area) to minimize delay or deflection of caribou.

Vehicle Traffic:

16. Traffic restrictions will be required from May 20 to Aug 20:
    a. May 20 through June 20:
        1. Traffic speed will be reduced to 15 mph.
        2. Traffic minimized (a reasonable target would be four convoy round trips per day between facilities). Nonessential operations requiring vehicles shall be suspended during this time period.
    b. May 20 through August 1:
        1. Caribou movement monitoring
        2.Traffic cessation when caribou crossings are imminent.

    c. May 20 through August 20:
        1. Convoying
        2. Busing of personnel
    d. June 21 through August 20 (goose area only; Figure 2):
        1. traffic minimized (a reasonable target would be four convoy round trips per day between facilities). Nonessential operations requiring vehicles shall be suspended during this time period.

17. Major equipment, materials and supplies will be stockpiled at each worksite prior to and after the period May 20 through June 20 to minimize road traffic.

Aircraft Traffic:

18. Use of aircraft larger than a Twin Otter from May 20 through August 20 will be for emergency purposes only.

19. Helicopter overflights within the goose molting area (Figure 2) will be suspended from June 15 through August 20.

20. Fixed-wing aircraft take-offs and landings will be limited to an average of one flight a day from May 20 through June 20 at aircraft facilities. Within the goose molting area (Figure 2), fixed-wing aircraft flight shall be further restricted from June 15 to August 20:
    a. limited to 2 round-trip flights/week;
    b. restricted to flight corridors established by BLM in consultation with the USFWS. Human safety and emergencies take precedence over these restrictions.

Garbage:

21. The handling and disposal of putrescible waste shall be accomplished in a manner to prevent the attraction of wildlife.

Other Activity:

22. No seismic activity or exploratory drilling from May 1 through September 30.

23. Water extraction from lakes used by molting geese (Figure 2) shall not alter hydrological conditions that could adversely affect identified goose feeding habitat along lakeshore margins.

24. Major construction activities (e.g., sand/gravel extraction and transport, pad construction, but not drilling) shall be suspended in the goose molting area (Figure 2) from June 15 through August 20 unless approved by the BLM.

25 Off-pad activity, including humans on foot, shall be prohibited in the goose molting area (Figure 2) from June 15 through August 20 except in emergencies, unless approved by the BLM.

26. Feeding of wildlife (including gulls and ravens) shall be prohibited.

27. Hunting by lessees' employees and/or by employees of lessees' agents, contractors and subcontractors shall be prohibited.

28. Public access to goose molting areas by way of or through the use of oil field facilities shall be prohibited.

Oil Field Abandonment:

29. Roads, airstrips and other gravel fill shall be removed upon field abandonment so as to render them unusable for enhanced access into the area.

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Appendix A
Teshekpuk Lake Area
Development Questions

The questions below refer to an assumed economically viable oil field in the Teshekpuk Lake area. This is the northern portion of the NPR-A planning area, bordered by the Ikpikpuk River on the west, the Beaufort Sea on the north and east, and approximately north latitude 70 degrees, 20 minutes, on the south.

Oil field Design

- What level of processing would be needed? For example, will CPFs, Water-flood STPs, CGFs, etc. be needed, or could enhanced recovery be handled from the Kuparuk or Alpine field? How much development triggers necessity for these facilities? What are the considerations in locating processing facilities remote from production pads?
- Would oil field support infrastructure similar to Deadhorse be required? If not, how would support services (e.g., mud contractors, tool services, logging and cementing,) be provided ? How much development triggers a requirement for a service center in NPR-A? Would the industry look to private sources (for example a KIC-type development on Arctic Slope Regional Corporation land) for support service center?
- Under what circumstances would a dock or other facilities along the Beaufort Sea coast be considered? Address two scenarios: onshore development within the NPR-A planning area and potential off-shore development.
- Would a jet airport be required, or could transportation needs be met with a smaller runway or with no airport?
- How would other drainages (e.g., Fish Creek) be crossed?
- How feasible is the use of horizontal drilling (sensu Niakuk) to reduce pad density? What factors (e.g., geological, economic) affect pad density and the potential use of horizontal and directional drilling?
- Is an oilfield without inter- and intra-connecting roads feasible?
- What are the trade-offs on elevating a pipeline 8 ft instead of 5 ft?
- Given the experience on the Badami project, are buried pipelines feasible?
- Would existing DEW-line sites at Kogru and Lonely be given priority as sites for oil and gas facilities?

Operations

Three levels of "reduced activity" are conceivable:

- Complete shut-in during the caribou calving/insect-relief and goose molting periods (May through mid-August.)
- Remote operation of production wells, with no humans on-site except in emergency.
- Minimally staffed production sites, with reductions in access (aircraft and vehicular) and suspension of drilling, well maintenance (e.g., work-overs) and other high-disturbance activities.

Compare the pros and cons of these scenarios. What sorts of seasonal shut-down or activity restrictions are feasible for constructing and operating oil fields? What risks/costs are entailed in remote operation of production wells? If production wells are not road-accessible, would there be a need to have operators flown in and out during the June-July period? Is it possible to house a small crew on the pad and commute from a remote site? How often would crews change out? What are the safety/environmental risks associated with lack of road access?

- Would industry close the oilfields to public access?
- How could solid waste collection, storage, transfer and disposal be handled to eliminate access to garbage by wildlife (bears, wolves, foxes, gulls, ravens) that may result in localized high populations of these predators? What can be done to improve current practices, and to enforce existing regulations?
- Where will gravel for construction come from? Are there alternatives (e.g., sand) that are feasible?
- What restoration strategies would be considered upon cessation of use, especially considering the importance of reduced human presence in the area, long-term?
- Would industry consider sharing seismic data gathered from one program, to avoid multiple seismic operations over the same area?

Appendix B

Molting Geese in the Teshekpuk Lake Area and Migratory Birds of the Arctic Coastal Plain

(From surveys conducted by U.S. Fish and Wildlife Service, Migratory Bird Management, Fairbanks, Alaska)

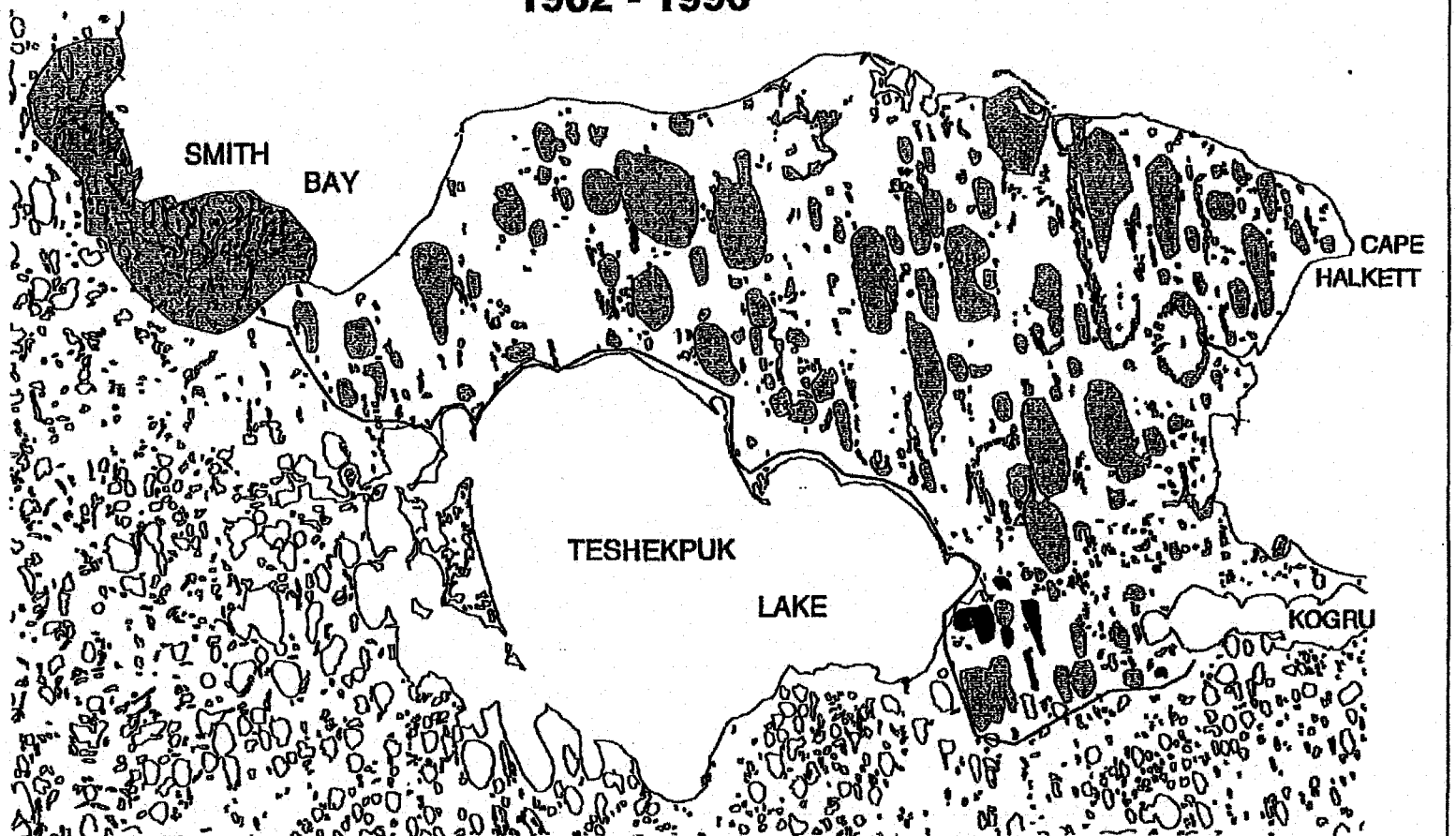
Aerial surveys of the Arctic Coastal Plain (ACP) have been conducted intermittently since 1977. Emphasis has been on waterfowl and related waterbird species. Initial surveys on the NPR-A were conducted by Rodney King during 1977 and 1978 and resumed on all waterbird habitats on the Arctic Coastal Plain in 1986. These surveys documented the importance of the Arctic Coastal Plain to northern pintail, oldsquaw, scoter and eider ducks as well as white-fronted geese, tundra swan and loons. From 1982 to present, aerial surveys have also been conducted on selected lakes in the Teshekpuk Lake area. These annual surveys during mid-July have documented the continued use by molting black brant, greater white-fronted geese, Canada geese and lesser snow geese. These surveys across the Alaska Arctic continue to record the importance of the area to many breeding and molting migratory birds.

The annual survey of molting geese in the Teshekpuk Lake area has documented a 15-year mean of 17,600 black brant, 13,000 Canada geese, 7,000 greater white-fronted geese and 200 lesser snow geese. Total average goose use for the 199 lake areas surveyed is 38,000 annually. This data emphasizes the importance of the area not only locally, but continentally.

Arctic Coastal Plain survey lines have been positioned to give statistically valid samples that verify the importance of arctic areas to migratory birds. The current 11-year survey has documented an average of 230,000 Northern pintail, 122,000 oldsquaw, 32,000 scaup, 12,000 scoter, and more than 20,000 eider ducks, as well as 105,000 greater white-fronted geese, 8,000 tundra swan and more than 30,000 loons. Significant proportions of these species habitually use the NPR-A and the North-east Planning Area. It is incumbent that these habitats are identified and their integrity preserved for continued use by all migratory birds.

LAKES USED BY MOLTING GEESE IN THE TESHEKPUK LAKE AREA

1982 - 1996



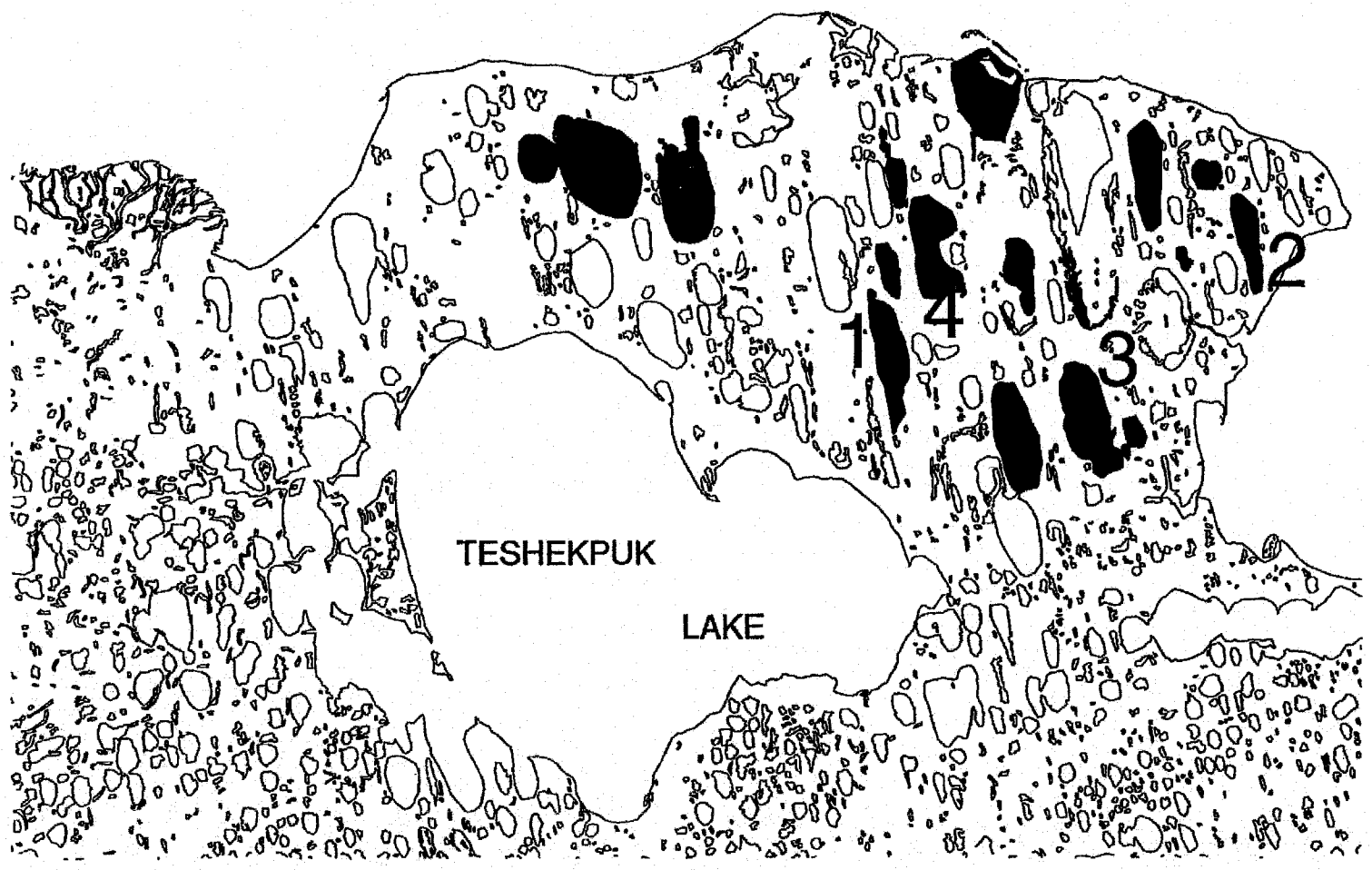
LIGHT SHADED LAKES ARE LAKES SURVEYED WHERE GEESE MOLTED

DARK SHADED LAKES ARE LAKES SURVEYED WHERE GEESE WERE NOT OBSERVED

DARK LINE SHOWS SOUTHERN BOUNDARY OF AREA SURVEYED

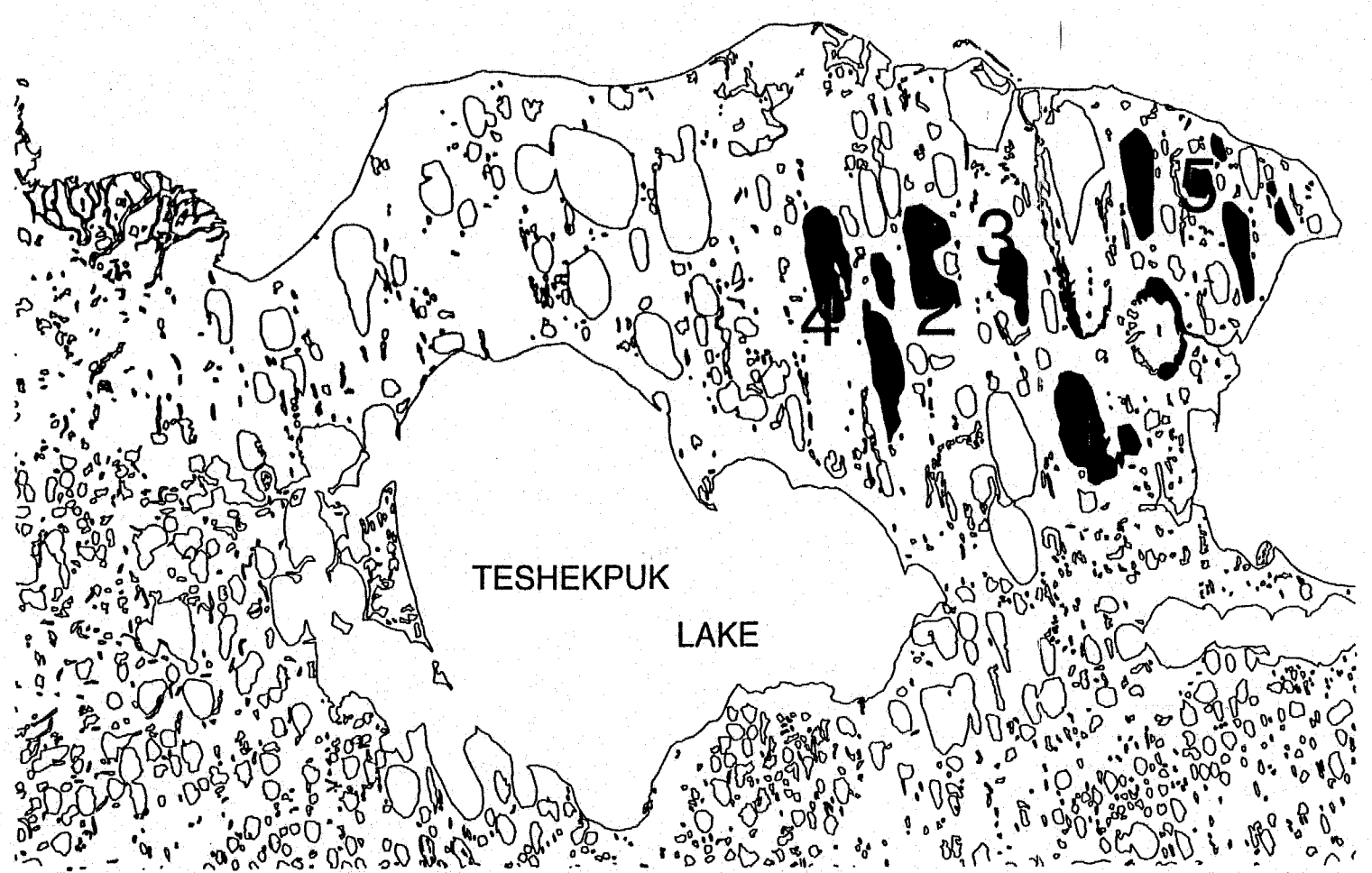
CANADA GEESE

TOP 15 USE LAKES 1982-1996



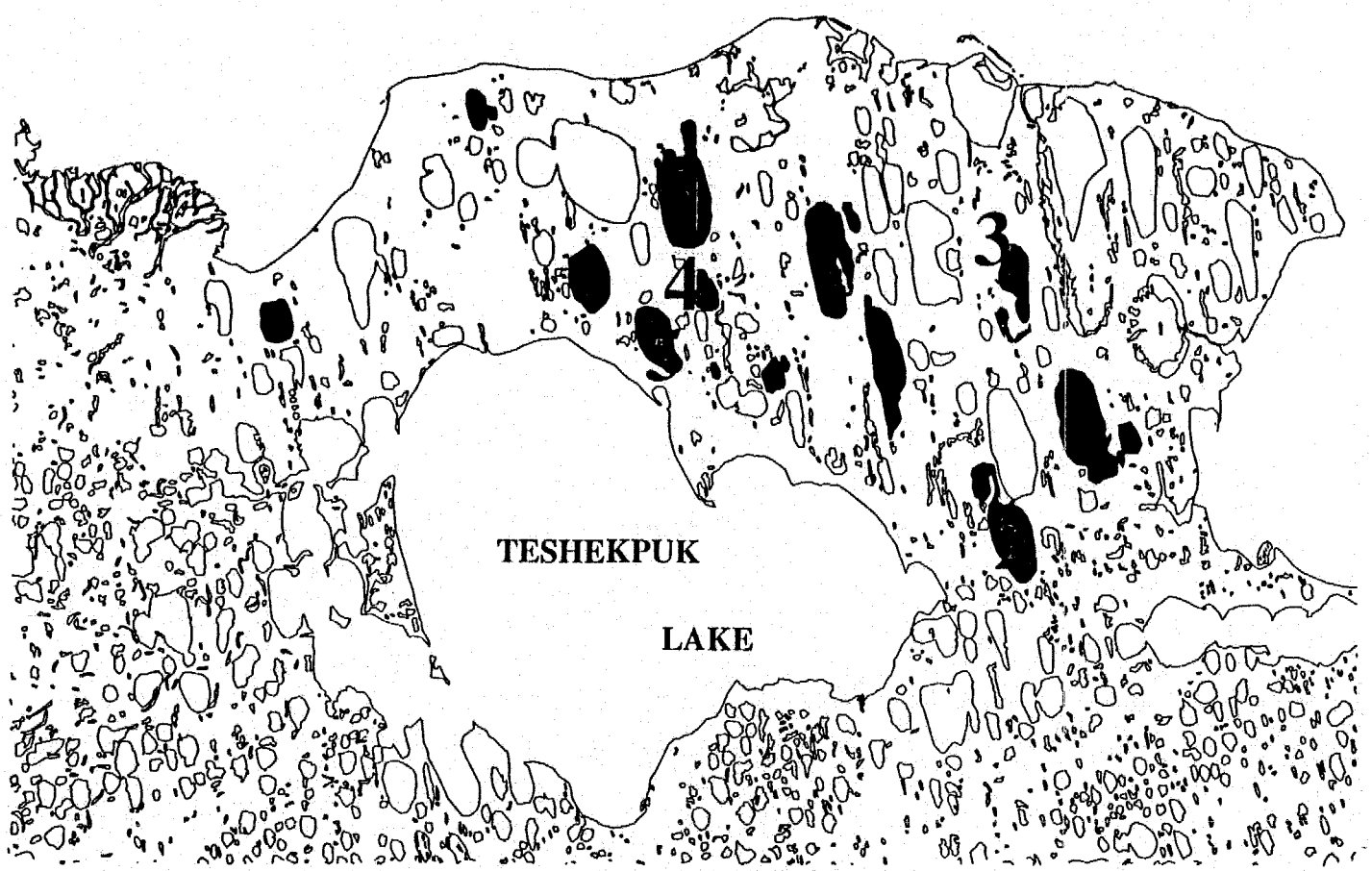
BLACK BRANT

TOP 15 USE LAKES 1982-1996



GREATER WHITE-FRONTED GEESE

TOP 15 USE LAKES 1982-1996



LESSER SNOW GEESE

TOP 15 USE LAKES 1982-1996